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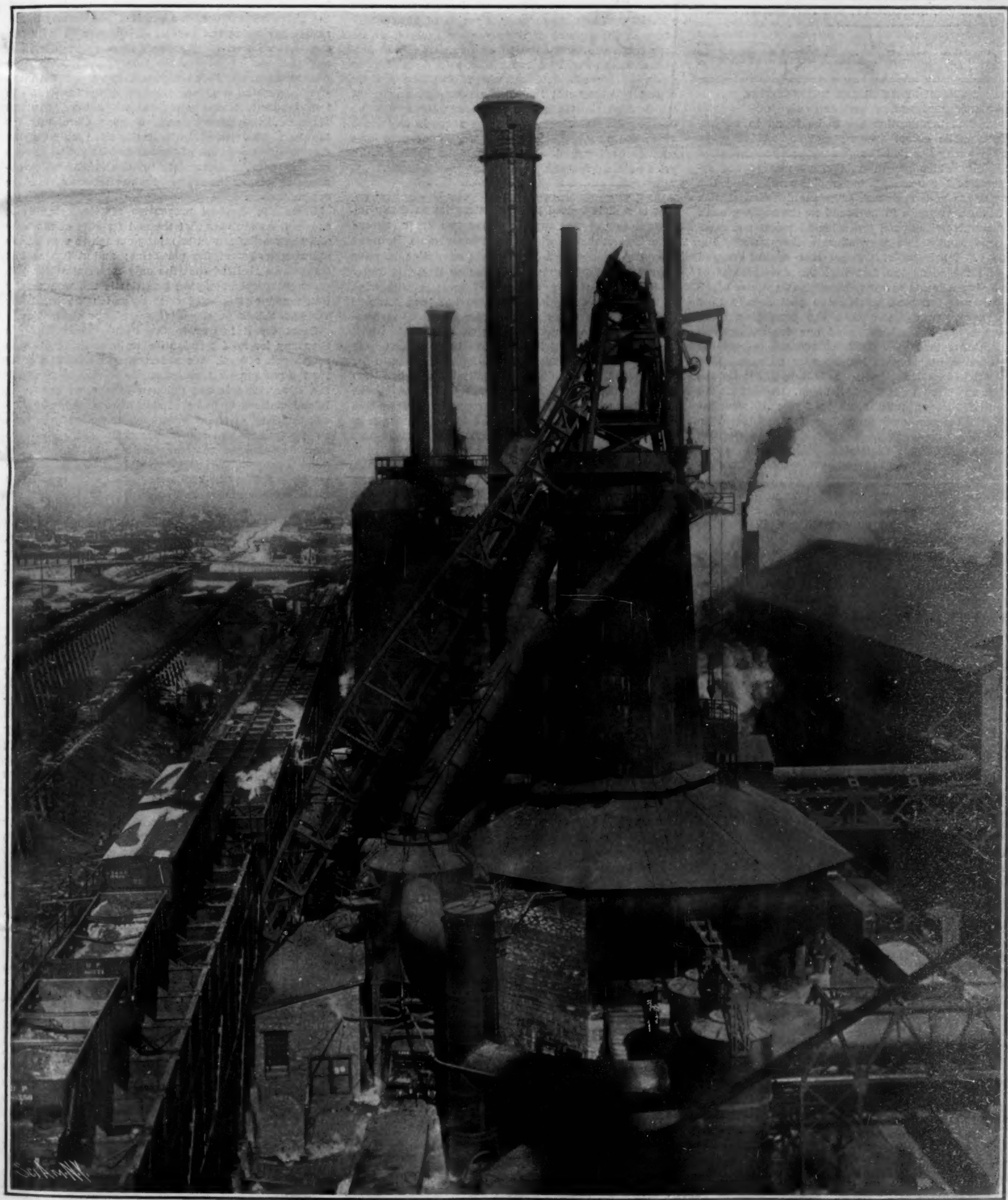

View of Complete Blast Furnace as Seen from the Charging Platform of Adjoining Furnace.

THE MINNEQUA WORKS OF THE COLORADO FUEL AND IRON COMPANY.—[See page 214.]

SCIENTIFIC AMERICAN

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NEW YORK, SATURDAY, SEPTEMBER 22, 1906.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

GROWTH OF AMERICAN UNIVERSITIES.

The safeguard against and corrective of the evils of our vast immigration are to be found in our excellent public school system; and so, on the other hand, we may say that the greatest safeguard against the perils which attend on the increase of the opportunities for accumulating rapid wealth, and the temptations and opportunities to acquire that wealth by devious ways, is to be found in the rapid growth of our universities, and the splendid moral and mental equipment which they offer to the youth of the country. We know of nothing that augurs so well for the future as the fact that the development of our universities is moving forward at an ever-accelerating rate. Indeed, during the past decade they have grown even faster than the population. The record of growth of thirty of our leading universities shows that from 1895 to 1905 the increase in the number of students has been as follows: Harvard attendance has risen from 3,550 to 4,559; Columbia, from 1,942 to 4,056; Michigan, from 2,818 to 3,742; Minnesota, from 2,233 to 3,633; Illinois has made the extraordinary jump from 607 to 3,391; Wisconsin has increased from 1,671 to 3,390; Cornell, from 1,689 to 3,330; California, from 1,787 to 3,200; Yale, from 2,350 to 3,124; Chicago, from 1,524 to 2,901; Northwestern, from 2,413 to 2,481; New York, from 975 to 2,882; Stanford, from 1,100 to 1,552; and Princeton from 1,109 to 1,384. This represents an increase of from 0.28 per cent in the case of the Northwestern University to as high as 459 per cent in the University of Illinois. Now, in the ten years from 1890 to 1900 the increase of the population of the United States was about 22 per cent; while during the same period at thirty universities the attendance increased 65 per cent. Among the many encouraging features in the growth of this country, there is none that carries brighter promise for the future than this ever-widening appreciation of the great educational institutions of the country.

GASOLINE ENGINES AND THE TORPEDO BOAT.

It was only a question of time before the internal-combustion engine would be given a serious trial in the propulsion of torpedo boats. The valuable quality of developing large power in proportion to the weight of the engine, and the wide radius of action for a given weight of fuel which can be secured by the use of gasoline, are qualities which have always commended themselves strongly to the consideration of the naval architect. The first serious attempt to produce a motor-driven torpedo boat of practical size and seagoing ability has recently been made by Yarrow, and he has succeeded in turning out a craft whose success was so pronounced that it has been purchased by the Admiralty, and seems likely to become the nucleus of a fleet of similar boats.

Of late years there has been a tendency to depart from the essential principles upon which torpedo flotillas were built. The original theory was that these flotillas should be made up of a large number of small craft, each of high speed, and presenting, because of its small size, a difficult object to hit, and costing but little to build. In the desire to raise the speed, the designers have been driven to increase the length, until from their original 75 feet torpedo boats have grown to an over-all length of 150 feet. The increase in their cost has necessarily led to a decrease in the number to be built, and consequently torpedo flotillas have lost that most valuable element of bewildering numbers, on which the chance of getting home a successful blow on a warship so largely depended.

In casting about for a type of boat which would accommodate itself to the demand for a restriction of size, it was realized that the motor-driven boat presented the best possibilities, and the matter has been so well worked out that the new motor torpedo boat, although it is only 60 feet long by 9 feet beam, has proved able to make a trial speed of 26.15 knots and sustain 24 continuously on a sea trip of many hours' duration. The economy of weights which has been secured by the adoption of the gasoline motor is shown by a comparison of this vessel with a torpedo boat of similar dimensions driven by steam, which, if it were carrying the same load, would be able to attain only 18 knots an hour as compared with 24. Furthermore, the radius of action of a steam-driven boat for one ton of coal would be only 60 miles, whereas for one ton of oil the motor-torpedo boat would be able to cover 300 miles. The fact that the little craft weighs only 8 tons, and is but 60 feet in length, adds enormously to its mobility in naval operations; for a whole flotilla of them could be loaded on to the cars, and transported to any desired point along the coast with ease and dispatch. The probable method of defense with these vessels would be to arrange a series of special stations, at the mouths of the rivers or harbors, where they could run in for shelter or supplies, and so protect a long stretch of coast line with a continuous chain of torpedo defense, which could be quickly concentrated by rail in large numbers at any point which might be threatened. Although for aggressive operations such craft as these can never in any sense supersede the battleship, it is worthy of note that over three hundred of them could be built for the price of a single "South Carolina" or "Michigan."

NORTH TUBE OF HUDSON RIVER TUNNEL COMPLETED.

It is seldom indeed that an enterprise so vastly important as the construction of the two great railroad tubes by means of which the Pennsylvania Railroad Company is to gain a long sought admission into the city of New York beneath the Hudson River, is forced to its completion with such rapidity and with such little ostentation. Public attention has been centered upon the huge excavation for the terminal on Manhattan Island, and upon the serious difficulties which have attended the driving of the tubes beneath the East River; and since the sinking of the shafts for the Hudson River tubes, practically nothing has been heard of the truly remarkable speed with which the two tubes were being pushed through to a connection beneath the river. Work on the tunnel proper commenced on the New York side on April 18, 1904, and on the Jersey side on September 1 of the same year. The shields of the north tube met on September 12, and at the present average rate of driving the shields of the south tube will meet about the 7th of next month.

The improvements now under way for giving admission to the Pennsylvania Railroad to New York and Long Island will cost altogether about $100,000,000. The North River division of this work, extending from the new terminal at Thirty-third Street and Eighth Avenue to the Hackensack Meadows, west of the Palisades, has a total length of 13,700 feet, and the length of the tunnel proper, lying directly beneath the Hudson River, is 6,100 feet. The tunnels on both sides of the river were driven through rock without the use of shields, to as great a distance as the nature of the material would allow, and in this portion of the work serious and rather puzzling obstructions in the way of piles, cribwork, and riprap, were encountered. As soon as the river mud and silt were entered, the shields were set up and the driving progressed steadily and rapidly and with a remarkable absence, for this kind of work, of fatalities and serious accidents. One miner lost his life by being suddenly submerged in quicksand, and there was one death attributed to the effects of compressed air. It must not be supposed, however, that the success in driving the tunnel was due to the absence of difficulties of a physical nature; for the greatest care had to be exercised in maintaining the pressure at the proper point to prevent a sudden blowout and the inflow of quicksand into the tube. This was particularly the case on the Jersey side, where, at a depth of 85 feet, a freely-flowing quicksand was encountered. On the New York side, moreover, not far beyond the bulkhead wall, the tunnel passed through silt, the surface of which lay dangerously near the bottom of the river. The difficulty at this point was overcome by the well-known expedient of dumping clay and forming a blanket on the river bed, which effectively prevented air-blowing. As the shield progressed, the heavy segmental rings were put in place, and the work advanced so rapidly that on one occasion as much as 12½ feet of distance was made in eight hours. The work remaining to be done consists in driving through the bottom of the tube a row of massive cast-iron screw piles, which will be sunk until they reach the underlying rock. These will be fastened securely to the tube, and will form a series of piers, upon which the structure for carrying the roadbed will be laid. The interior of the tube will be entirely lined with about two feet of concrete, which, in conjunction with the massive cast-iron shell and the heavy screw piles, will render the work so stable as to insure the permanency of these tunnels for all time.

STEEL PASSENGER CARS FOR TRUNK RAILROADS.

It is good news to those of us who realize that the loss of life on steam railroads is altogether too large, to learn that at last one of our great trunk lines has decided to adopt the all-steel passenger car as a standard type for all new equipment. The steel car, as we have often pointed out in the columns of this journal, is the only sure preventive of those two fruitful causes of death and injury in railroad wrecks, namely, telescoping and fire. Telescoping, or the crushing of one car directly into the one adjacent to it, should, more strictly speaking, be known as shearing; for when telescoping takes place, the mischief is due to the massive and enormously strong platform of one car lifting above the one adjacent, and sliding forward upon it, cutting through the light framework of the sides until the body of the telescoped car is cut loose from the under-framing. As the entering platform is forced resistlessly along the surface of the one on which it climbs, its forward edge passes through the car, usually at about the level of the passenger seats, and the passengers are crowded forward, mixed up with the wreckage of the seats, the splinters of the framing, and the fragments of heavy plate-glass windows, with all those resulting horrors with which we are only too familiar. The risk of fire is due to the ignition of the combustible woodwork of the car and its yet more combustible paint and varnish, by the inflammable illuminating gas, or the scattered white-hot coals from the engine firebox.

Obviously, the best preventive of telescoping is to so construct the cars that the end framing of the body and the vestibules will be strong enough to prevent the shearing action of the platforms; and it has at last come to be realized that the only material which presents the proper resisting qualities is the wonderfully tough and elastic mild steel of which we build our skeleton buildings, our bridges, and our steamships.

Great credit is due to the Pennsylvania Railroad Company for its determination to build its future passenger cars of steel. We understand that the first order for the passenger-car equipment to be used in the Hudson River tunnels and the new Manhattan and Long Island stations is to be of steel throughout, and that one thousand of the new cars are to be ready as soon as the tunnels and station are completed. The Pullman Company is now constructing the first all-steel sleeper car, which if it gives satisfaction, will be followed by five hundred Pullmans of similar design. The main feature of the new car platform is a massive central box girder, 24 inches wide by 19 inches deep, which will extend throughout the full length of the car from coupling to coupling. From this backbone, deep steel cantilevers will extend transversely, four on each side, to carry the sides of the car, which will be composed of steel girders of unusual strength. The floor framing will be covered with a continuous flooring of steel plates, strongly riveted to the steel longitudinal girder and the cantilevers of the floor framing; and over this plating will be placed a cement finish in imitation of stone which will be laid while in the plastic condition. Security against telescoping will be obtained by making the steel vestibule end and corner posts of such a form and strength as will present great resistance to transverse shearing; and should the adjoining platform be forced through these, it will bring up against the end door posts, which will be of a very deep section, securely riveted to the main box girder of the platform, and to a horizontal steel strengthening plate at the roof of the car. Inside and out, the lining will consist principally of steel plating, and no wood or inflammable material whatever will be used except for the top of the seat arms, where it has been introduced for the comfort of the passengers. The car is equipped for electric lighting, the current for which is furnished by storage batteries placed beneath the car; and it is to these batteries largely that the great weight of the new car is due; for while the standard wooden coach weighs about 85,000 pounds, the new steel car has a weight of 103,550 pounds. This increased weight, while it will be looked at dubiously by the master mechanic who has to provide the motive power, has the advantage that it greatly reduces vibration and noise and, therefore, adds to the comfort of the passenger.

JAMES DREDGE.

The field of technical journalism has suffered a heavy loss in the recent death of the late James Dredge, editor of our esteemed contemporary Engineering. Among engineers there were few contemporary names more widely known than his; for outside of his editorial work, which extended over a period of thirty-three years, Mr. Dredge was honorably known for the active part which he took in the great international exhibitions. He was identified with the Vienna exhibition of 1873, and later with the Centennial exhibition at Philadelphia of 1876, and the Paris exhibitions of 1878 and 1899. He was a member of the British Commission for the Chicago exhibition of 1893. He held similar official positions with the Antwerp exhibition and that held in Brussels, and he was one

of the vice-presidents of the British Commission for the Milan exhibition of the present year.

Mr. Dredge was born at Bath, July 29, 1840. He was educated as a civil engineer, and it was in the course of his professional work that he first made the acquaintance of the late Zerah Colburn, and that other distinguished engineer, the late Alexander L. Holley. Zerah Colburn, who had held the position of editor of The Engineer, London, left that journal to establish one of his own, the first number of which, under the title of Engineering, was published in 1866. It was through Mr. Colburn that Mr. Dredge became one of the staff of the journal with which he was to be honorably associated for so many years. Not only was Mr. Dredge a frequent visitor to this country; but at all times he took the most lively interest in its growth and prosperity. Conspicuous among his early writings were a series of articles on American works, included in which was a series of articles on one of the leading American railroads, which was subsequently published in book form. The visit of Mr. Dredge to this country in 1890 was made for the purpose of delivering an address in connection with his unveiling of a bronze bust of Holley in Washington Square, New York. He was a member of the British Institution of Mechanical Engineers and of the Institution of Civil Engineers. He was also elected an honorary member of the American Society of Mechanical Engineers.

THE ADVANTAGES OF CRANK AXLES FOR LOCOMOTIVES.

BY W. F. CLEVELAND.

The pistons of a locomotive, and their reciprocating connections, during acceleration and retardation stresses, may be considered, so far as these disturbing forces are concerned, as captive projectiles, whether propelled by steam in the cylinders, or through the cranks and axles, by the momentum of the train when steam is shut off. In the former case, their unbalanced inertia is applied to the cylinder heads in precisely the same way as the recoil of a gun is occasioned, and induce the racking strains which occasion the serious repair bills, itemized as broken frames, deranged adjustments, bad steam distribution, and a hundred other ills, that may be diagnosed as general locomotive debility.

During the excessive speeds of modern railway travel, the strains induced by the unbalanced inertia forces of these parts are largely occasioned when steam is shut off in the descent of grades and the approach of stations. The strains are then applied through the rods and cranks to the frames at the main bearing connections, the momentum of the train being the propelling energy, but the destructive effects are of the same character and proportion. They are partially and inadequately balanced by the counterweights, whose service is further vitiated by the variable track pressures which they induce, and by the unbalanced strains of their continued action at both centers, when the inertia of the piston and its connections has been removed. During piston acceleration, the effective steam pressure, as measured by the crank stresses, is diminished to the extent of the static inertia of the reciprocating parts, which is also unbalanced to an equal extent, but the loss is repaid by the dynamic inertia of retardation in the latter half of the stroke.

The retardation stresses of the latter half of the piston stroke are applied to the cranks, in unison with those of the effective steam pressure, but as the latter are balanced between the piston and the cylinder heads, the former remain unbalanced, except by the untimely action of the counterweights, and like a retarded or captive projectile, communicate their disturbing forces, through the rods and cranks, to the main bearing connections, where they are absorbed by the frames and general mass of the locomotive. These forces of retardation and acceleration of the reciprocating parts act in unison with the course of the train's motion during one-quarter of each revolution of the drive wheels, but in contrary directions to one another during the next quarter. That is, with the piston of the left-hand engine at the upper (crank position) half stroke, and the opposite piston at head center, the retardation stresses, during the ensuing quarter, on the one side, and the acceleration stresses on the other, both act in unison with the direction of the train's motion; but in the next quarter they act in contrary directions to one another, as the change from retardation to acceleration takes place with the reversal of the piston motion, and the change from acceleration to retardation during the course of the piston stroke. The conditions and changes are the same at the back centers, except that the directions of the disturbing forces are reversed. The cycle thus begins with these forces acting in unison for one-quarter of a revolution, and in the direction of the train's motion, then changing, during the next quarter, to contrary directions to one another, then acting in unison during the third quarter, but contrary to the direction of the train's motion, and during the last quarter, pushing or pulling in contrary directions. The conditions will be more readily understood by keeping in mind the fact that, during the piston acceleration and retardation of the first quarter of the cycle, the pistons move in contrary directions, and therefore the disturbing forces act in unison of direction, because the acceleration forces are always contrary, and the retardation forces always in harmony, with the direction of the piston movement. During the second quarter of the cycle, the pistons move backward in unison, and the disturbing forces are therefore contrary to one another in direction, and so on to the end of the cycle.

It is therefore evident that the conditions are far worse than if these forces continually acted in contrary directions, as the sudden changes at each quarter revolution, even at moderate speeds, are productive of racking strains, aggravated by lost motion in the working parts, and culminating in crystallization and breakage of the frames, and impairment of the general efficiency of the locomotive.

A most satisfactory change for the better may be effected, however, simply by the use of crank axles, placing the cranks as closely together as possible, in order to centralize the strain, and at the same time protect the cylinders from heat radiation and cylinder condensation, by their inclosed positions. During the first and third quarters of the cycle, when the disturbing forces act in unison, the distribution of the strain will be practically the same as with outside cylinders, and no racking stresses will be occasioned; but during the other quarters, when the disturbing forces are contrary in direction, the approximately central positions of the cranks, considered in connection with the inertia of the wheels and outer parts of the axles, will eliminate the racking strains, and practically balance the disturbing forces. Light counterweights only will then be required to balance the coupling side rods and wrist pins.

Crank axles have been in use for many years on English railways. It is claimed that American locomotives have made a poor record on these roads in endurance competition with those of English manufacture, and the main cause is probably not far to seek; but the prejudice against crank axles in America is gradually being eliminated by improved methods of manufacture, and by the unqualified success of balanced compound locomotives running in this country.

INVESTIGATING THE NUTRITIVE VALUE OF MEAT.

BY ELIZABETH C. SPRAGUE.

A billion and a half dollars are spent every year by the people of the United States for the meat they eat—about a third of the whole amount expended for raw food materials. This immense sum is used to purchase a food of whose nature and dietetic value very little is known. Every one thinks he knows from experience what suits him best, or at any rate, as one woman expressed it, "likes to eat what he likes, and not what is nourishing."

It has proved financially profitable to study the food of plants, to analyze the soil where they are to be grown, discover what food element is lacking, and by supplying this produce a more perfect and plentiful crop. Extensive experiments are carried out to determine by what system of feeding the most marketable steer yielding the largest profit can be raised. Even the question of whether the corn should be ground into a meal or fed to the animal on the cob is thought worthy of consideration and experiment. This, because the value of such care and experiment can be demonstrated in the returns in dollars and cents. A man's health, strength, and efficiency depend upon the food he eats, but it is less easy to show the results of experiments with human beings than with plants and the lower animals. In matters of food more than in anything else the human race has been content to follow its instincts. Now, however, the time has come when it does not seem sufficient to depend upon these alone. We have begun to appreciate the ability of science to first interpret the leadings of instinct, and then discover means of improving upon them. Through the domestic science movement many of the more intelligent housekeepers have come to realize the need for more accurate information regarding the nutritive and economic value of different foods, of methods of cooking, and related subjects. To supply this need the government, through the Office of Experiment Stations of the Department of Agriculture, has established a system of Nutrition Investigations. These include studies of the food consumed by typical individuals, families, and groups in colleges, hospitals, and other institutions, to determine representative food habits, to discover the principles underlying the natural selection of food, and to establish a rational basis for such selection.

While very few people in civilized countries actually starve, many have less food than they need, and multitudes have less than they would buy if they could. On the other hand, many people have more food than they should have. Careful preparation and skillful cooking fits much food for use which would otherwise be thrown away, and makes what is already edible more easily available, and therefore more valuable to the body. We do not, however, know a great deal about the effect of cooking upon food and its influence upon digestibility. Moreover, whenever money is scarce and the most should be made of food, there the ignorance, carelessness, and incompetence of the cook are proverbial. Therefore the nutrition investigations have included researches upon the preparation of some of the most important articles of diet, particularly bread and meat. It seems especially suitable that the investigations upon the chemistry of meat should be carried on in Illinois, which contains the greatest distributing center for this food in the world.

At the University of Illinois several laboratories of the Department of Chemistry are devoted to this study. Not only are different cuts and kinds of raw meat analyzed to discover differences in composition and therefore in nutritive value, but they are also cooked in various ways to determine the comparative value of different methods of cooking, the losses and changes in composition which occur, and the influence of these upon the digestibility of meat.

A standing rib beef roast, for instance, is shown by analysis to consist of 42 per cent refuse or inedible material, bone and gristle, 24 per cent water, 26 per cent fat, 7 per cent proteid (muscle-building substance), 0.7 per cent organic extractives. Therefore, if one pays 75 cents for a 5-pound roast of this character, 31 cents goes to pay for waste material and 43.5 cents for edible meat divided as follows: 18 cents for water and 25.5 cents for the actually nutritive material.

The same roast, boned and rolled ready for cooking, would weigh about 3 pounds, 44 per cent of which would be water, 12 per cent proteid, 1.4 per cent organic extractives, 41 per cent fat, and 0.6 per cent ash. After cooking it would weigh about 2½ pounds if cooked very rare, and contain 40 per cent water, 14 per cent proteid, 43 per cent fat, 1.5 per cent extractives, and 0.7 per cent ash. Having lost more of water than of the other constituents during cooking, it has become more concentrated, and a pound of the cooked meat contains as much nutritive material as 18 ounces of the raw meat.

It is difficult for the uninitiated to appreciate the extent of the work involved in such investigations, but some idea may be gained from the fact that a single cooking experiment, including the analysis of the meat before and after cooking and of the accompanying broth or drippings, means that one hundred and forty chemical determinations must be made—sufficient work to take all of one man's time for three weeks. Moreover, each cooking experiment must be repeated a number of times, in order to collect sufficient and indisputable evidence to justify definite conclusions. In the course of these investigations nearly a hundred raw meats have been analyzed, and three hundred cooking experiments performed. Results which are of practical as well as scientific value have been obtained.

When meat is cooked in water, it may lose from 10 to 50 per cent in weight, depending upon the conditions of cooking. Most of this loss is due to the water cooked out of the meat. Almost half of the water present in the raw meat is lost in this way, so that it is not surprising that boiled meats should seem so dry. Meats cooked by roasting lose from 13 to 37 per cent of their total weight. Only about a third of the water is lost under these conditions, leaving the meat much more juicy. The roasted meat loses very much more fat than does the boiled meat, but this is not important, since it may be saved in the drippings, and more fat probably remains in the meat than will be eaten.

The loss of the organic extractives—a class of substances about which very little is known, except that they are responsible for the flavor and stimulating effect of meat—is quite a different matter. When the meat is broiled or roasted only a small part of these exude, but if they are cooked in water more than three-fourths of them are dissolved and pass into the broth. The meats from which the soluble constituents have been removed are very much less effective in stimulating the flow of the digestion juices, and therefore have a lower dietetic value than those which retain more of these substances. The juiciness, tenderness, and flavor of a roast or porterhouse steak are of sufficient physiological importance to justify to some extent a preference for these, even at the higher price one must pay for them, than for meat for boiling or stewing.

In cooking meats in water the losses increase with the length of time and temperature of cooking. The smaller the size of the pieces in which the meat is cooked, the greater also will be the losses. In roasting the losses increase the more thoroughly the meat is cooked. Meat that is cooked well done loses fully twice as much as that which is left rare. This means that the latter is not only more juicy, but contains more of the soluble flavoring constituents than the former. Being in a condition that resembles raw meat, it is more easily though not more completely digested than is the well-done meat. All meats, irrespective of the method of cooking, have a high food value when judged by the kind and amount of nutritive ingredients present.

THE ALCOHOL SMUGGLERS OF PARIS.

BY AN OFFICER OF THE PARIS CUSTOMS HOUSE.

ALCOHOL without a doubt is the article most often smuggled through the gates of Paris, and this is due to the fact that the tax upon it has steadily increased during the past few years. Naturally, increased taxation means higher profits on contraband goods and, therefore, quickens the ingenuity of smugglers. Under our very eyes these men annually pass thousands of gallons of valuable spirits into the city, where it is readily disposed of at high prices to makers of perfumes, or to liquor dealers who use it for adulterating their goods. Yet we keep a sharp watch on all who pass through the gates of the capital. None can enter until he satisfies us that contraband articles are not hidden on his person; no vehicle is admitted until it has been thoroughly searched, and every cask of liquor must be declared before the owner is authorized to pass on. Nor can any one question the severity and conscientiousness of the inspection, as the men under my orders have a share in the proceeds of the sale of any alcohol seized at the barriers. At given periods this is sold by the municipal authorities, one-half of the receipts going to the city funds, and the other half to the *octroi* employees. These men are not over-well paid, so they look forward to increasing their incomes by extreme vigilance in capturing smugglers.

I can assure my readers that it is well worth while to smuggle alcohol into Paris. The dues on each liter or quart amount to four francs fifteen centimes, say eighty-six cents. Imagine the profit to be derived by anyone who succeeds in smuggling several thousand gallons of alcohol a year. Among the thousand-and-one methods employed by smugglers, some very curious ones have come under my observation during the twenty-odd years that I have been connected with the service. The accompanying illustrations represent some of these. They are reproductions of special photographs taken in the warehouses of the Hotel de Ville, where are stored all sorts of ingenious smuggling apparatus. They are so numerous that quite a museum could be formed, were it not for the fear of teaching dishonest men how to defraud the government.

For several months smugglers disguised as stone masons carried wooden beams through the gates without our suspecting for a moment that they were hollow and contained large quantities of alcohol. But the fraud was eventually discovered by pure accident, as nearly always happens. One day, just as the last man of a squad passed the barrier, with a cheery "*Bonjour, camarades*," he stumbled over a stone and fell headlong. Fearing that the man was hurt, I darted forward to help him to his feet, but had no sooner done so than to my utter astonishment he arose with astounding rapidity and made off, leaving the beam behind him; moreover, his companions also took to their heels. The reason for their flight was soon apparent. From one end of the beam there oozed a thin stream of liquid, which I instinctively detected as alcohol.

Double-bottomed bottles and other vessels are common contrivances of smugglers. In order not to awaken our suspicion they are usually filled with some beverage, beer or wine, and this is duly declared by the man in charge of the vehicle. We have often been swindled in this way in the past. Now we are never deceived by double-bottomed bottles, nor for that matter by hollow horse-collars (see illustration) which was at one time another favorite dodge of the alcohol smuggler.

But I have come across even more ingenious tricks than these. In smuggling alcohol through the gates of Paris, it is not at all necessary to have a vehicle and a bulky cargo. A single man can carry quite a quantity of alcohol, and in quite a different sense from that usually applied to drunkards. A smartly-dressed gentleman is represented in one of the accompanying photographs. Under his spotless waistcoat and white shirt, he carries an India-rubber plastron brimful of alcohol. True, his appearance is rather bulky, but then he can probably put that down to good living, and ten to one he will slip through our hands. Sometimes the India-rubber waistcoat is replaced by a tin one, also filled with alcohol; and I have known even an immaculate-looking tall hat to be found to contain some heavily-taxed liquor. Then again this class of smuggler will often carry an innocent-looking portfolio which contains not papers, but alcohol. Thus surrounded by alcohol on all sides, he walks past us with the gravest of airs, taking care not to make a false step, otherwise his heavily-loaded hat might fall to the ground and reveal the fraud. I have known this class of smuggler to be accompanied by a fashionably-dressed lady, under whose skirts there has been enough alcohol to stock a small saloon. These two defrauders are very difficult to catch, for the reason that they do not need to pass through the gates of the city, but can come into Paris by boat, and my colleagues at Charenton or Bercy are hardly likely to detect them in their perfunctory examination of baskets and hand bags. Sometimes, of course, suspicion is aroused, and the well-dressed gentleman and lady are followed, not by ordinary *octroi* employees, but by detectives who are always on duty near the barriers and landing stages.

During a period of over six months the customs employees at the various barriers at Paris saw two men regularly pass before their offices, carrying a very fine funeral wreath. Naturally, they never asked them to pay dues on such an article as that, and never suspected for a moment that it contained 40 liters of pure alcohol. The smugglers took every precaution against discovery, avoiding, for instance, passing through the same barrier twice running. However, the trick was eventually discovered by an officer who insisted on examining the wreath, and found that it contained a tin interior filled, of course, with the valuable spirits.

Among the many smugglers whom I have caught red-handed, there was one man who disarmed suspicion for months by his pleasant manner. He would come up in the most friendly way imaginable, shake me by the hand, wish me "*Bonjour*," ask after my health, and talk for half an hour at a time about the news of the day. All this time his vehicle was standing at the gates, a vehicle which we little suspected contained no end of untaxed alcohol. Apparently his cart was filled with beer and cider, for which he always paid. One day, however, he was caught. A young employee who had never seen him before was alone on duty, and insisted on ransacking his vehicle. Nothing save the casks of beer and cider was to be seen, and he was about to let the man pass when a drop fell on his hand from the roof of the covered cart. He looked at the spot of liquid, smelt it, and at once detected that it was alcohol. In the roof of that vehicle was a cleverly-arranged tank let into the woodwork, and in addition to this hundreds of liters of alcohol were stored under the driver's seat. You can judge of the astonishment of myself and colleague when we heard that the *brave homme*, who for six months past had inquired so kindly about our wives and children, had been throwing dust in our eyes.

You can now imagine what large sums of money the city of Paris loses through the ingenuity of smugglers. The alcohol thus introduced into the city is used for various purposes, sometimes for making perfumes, but more often, I suspect, for concocting cheap alcoholic beverages. Once within the city, the smuggler can easily find a market for his produce. Frequently he is in the employ of a manufacturer who thus realizes enormous profits on his goods. I can assure you we customs officials have often a very hard task. In spite of all our endeavors, smugglers gain their ends. We are pitted against a class of men who are sometimes perfect geniuses—men who had they directed their energies into other channels, might have been inventors with a wide reputation, and with incomes honestly earned.

1.—Can which contained alcohol, with its false interior; also portfolio used for alcohol smuggling. 2.—India-rubber waistcoat for smuggling alcohol; also rubber bag for attachment to the skirts. 3.—Hollow beams in which alcohol has been smuggled. 4.—Driver's seat with a hollow interior. 5.—Hollow horsecollar.

THE ALCOHOL SMUGGLERS OF PARIS.

Fireless Cook Stoves.

In an address to an audience consisting largely of working people, Mrs. Back, wife of the director of the industrial school (Gewerbe Schule), at Frankfort, brought to the attention of her hearers the following interesting information in regard to a new article of kitchen furniture—the hay box, or fireless stove.

Every housewife knows that a pot of coffee can be kept hot for a considerable length of time, without the aid of fire, simply by wrapping it securely in a dry towel in order to hinder the escape of heat. It now seems very strange that the world has been so slow to make a practical and more extended use of this idea.

At the Paris exposition of 1867 much attention was attracted by a wooden box lined with wool and felt, which was called "the Norwegian automatic kitchen." In this box food which had been boiled for only a very few minutes continued to cook slowly and in two or three hours was found to be ready for the table. For

some unexplained reason all efforts to bring this useful novelty into general use proved unsuccessful until the matter was recently taken up systematically and with more enthusiasm in Baden. The propaganda is now being successfully pushed in Berlin, Munich, Frankfort, and other cities by means of popular lectures and public demonstrations of the convenience and practical value of this method of cooking.

Mrs. Back stated that she has now been using the hay box for thirteen years, and that it has greatly reduced for her the cares and annoyances of housekeeping. At first she used the box merely for the purpose of keeping finished food warm, but it was not long before she discovered that the process of cooking continued in the box. She thereupon extended its use, making a series of experiments which resulted in pleasant surprises. She soon found that she could finish in the box all boiled and roasted meats, sauces, fish, soup, vegetables, fruit, puddings, etc. Of course the box cannot be used for beefsteaks, cutlets, pancakes, and the like, articles whose chief attraction lies in the crispness resulting from rapid cooking on a hot fire, but when food of this kind is being prepared it is a great comfort to know that the rest of the meal is ready and hot in the box.

In any household such a box will be found of great advantage, lessening the worries of the housewife and cook, and leaving much more time for other duties and recreations, but for working women it is more than this—it is almost indispensable.

A little patience and interest will secure all the experience that is needed and remove all doubts. A few experiments will teach how much preliminary cooking on the gas stove is required for different substances. In general, it will be found that two or three minutes of actual boiling on the fire is amply sufficient for vegetables, while roasted meat requires twenty to thirty minutes. Most articles should remain tightly closed in the box for two or three hours, though they can be left there to keep hot for ten or twelve hours, if necessary.

Rice, dried beans, lentils, dried fruit, etc., should first be well soaked in cold water. After being allowed to boil for from two to five minutes, one to two hours in the box will prepare them thoroughly for the table. Cabbage should be prepared the evening before it is to be used. It should be placed in the pot with very little water, cooked well in its own juice, and put overnight in the hay box. Just before dinner on the following day it should be warmed on the stove. Cauliflower and other soft vegetables should be merely brought to a boil and then placed for an hour or two in the box. It will be found that soups are greatly improved by being allowed to develop for two or three hours in the hay box. The covers of the pots should, of course, not be lifted when the pots are being transferred to the box. By the old method of cooking, it is necessary to boil dried beans two and one-half to three hours. When the hay box is used, boiling for five minutes will be found sufficient. This will give a clear idea of the amount of fuel saved.

Science teaches that many substances become ready for use as food at temperatures below the boiling point; and that, unless the pots are hermetically closed, a temperature exceeding 212 deg. F. cannot be attained, no matter how much fuel is consumed nor how long the boiling is continued. Accordingly, the object to be kept chiefly in view is to retain the heat as long as possible when it has once been developed.

One of the first things for a novice to learn is how much water to use. It will soon be found that too much is better than too little, and that if beans, peas, lentils, oatmeal, etc., have less water than they can absorb, they cannot become properly cooked, no matter how many hours the process is continued. No water should ever be poured from the pots, not even from potatoes, as it always contains valuable salts derived from the cooking substances whose loss must lessen the alimentary value of the vegetables or meat.

The hay boxes now being offered for sale in German stores are usually lined and partitioned with hay, felt, etc., and the receptacles are furnished with covers which can be securely locked. Such boxes are no doubt useful when food is to be transported—for instance, from restaurants; but there is one serious objection to them—their immovable felt and upholstery may become moist and moldy. A home-made hay box will usually be found cheaper and more practical. Almost any box will do which has a tightly-fitting cover. The wood of which it is made should not be too thin, and of course there should be no knot holes or cracks. Old trunks and valises may sometimes be successfully utilized in this way.

The box should be loosely filled with shavings, paper, or hay—the last mentioned being probably the most satisfactory. The hay should be renewed every two or three weeks. Before the pots are ready the requisite number of nests in the hay should be prepared, and when the pots are placed in these holes the hay should be packed under and around them tightly. Any kind of pots can be used, although of course earthen ones hold the heat best. The tighter the top fits the better, but if the food is to be used within six or eight hours, it is not necessary that they should be of a kind which can be hermetically closed. Ordinary tops will be found perfectly satisfactory. When the pots have been placed in the box carefully and without lifting the lids, they should be covered with a pillow and the lid at once securely closed.

When not in use, the box should always be left open and the hay loosened, the pillow being hung in the air to dry thoroughly.

The chief advantages of the hay box may be summarized as follows:

1. The cost of fuel can be reduced four-fifths, or even nine-tenths.

2. The pots are not made difficult to wash; they are not blackened, and they will last for an almost indefinite period of time.

3. The food is better cooked, more tasty, more nutritious, and more digestible.

4. Kitchen odors are obviated.

5. Time and labor are saved.

6. There is no need of stirring nor fear of scorching or burning.

7. The cares of the housewife are lessened, and her health and happiness are thus protected.

8. The kitchen need not be in disorder half of the day.

9. Warm water can always be had when there is illness in the house and during the summer when fires are not kept up.

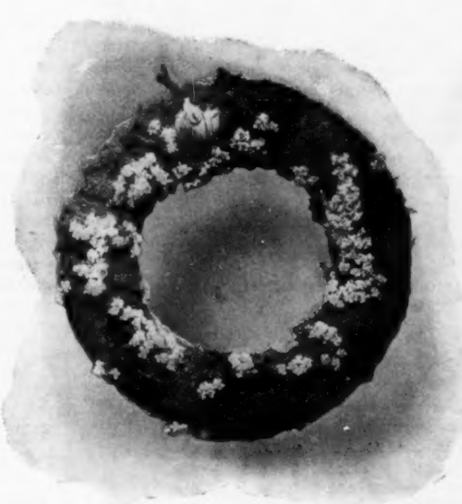
10. Milk for the baby can be kept warm all night in a pot of water.

11. Where workmen's families live crowded in one or two rooms the additional suffering caused by kitchen heat is obviated by the hay box, for the preliminary cooking can all be done in the cool of the morning.

12. At picnics the appetites of young people are only half satisfied by sandwiches and other cold food. The hay box can furnish a hot meal anywhere and at any time.

13. Similarly, men and women working in the fields or having night employment can take with them hot coffee, soup, or an entire meal, thus avoiding the necessity of returning home at a fixed hour or having it brought to them by another member of the family.

14. When different employments make it necessary for the various members of a family to take their meals at different hours, this can be arranged without a multiplication of work with the assistance of the hay box. Of course it is necessary that the box be kept perfectly clean, as otherwise it may become sour or musty.—George H. Murphy, Consular Clerk, Frankfort, Germany.



This Funeral Wreath is Tin-Lined and Holds Forty Liters of Spirit. After Passing the Customs Many Times, the Fraud Was Detected.

India-Rubber Plastron Worn by Women.

Tin Waistcoat for Carrying Alcohol.

Even a Hat Is Used for Smuggling Alcohol.

THE ALCOHOL SMUGGLERS OF PARIS.

Aside from the production of cattle, by which Argentina first attracted attention, the country is known as a wheat grower, and will continue to increase in importance in this direction. The extraordinary gain made during the year 1903-4 in crop raising as against animal production was not due to any unnatural or phenomenal causes. Exports of farm products during the first six months of 1904 increased more than a third over the same period in 1903, which was considered a very good year. At the same time the exports of animal products fell off about 8 per cent. The total wheat export of Argentina up to the 1st of October, 1904, was 100,000,000 bushels, while the total for the year 1903 was only 75,000,000, and for the preceding year only 23,690,070 bushels. The wheat area is rapidly extending to the west and southwest. The acreage estimated by the Argentine Department of Agriculture for the past season was 9,275,178, and the estimated production 124,160,636 bushels. This is chiefly in the provinces of Buenos Ayres, Santa Fe, and Cordoba, with smaller amounts in Entre Rios and in the Territory of the Pampa.

A novel instrument for illustrating the magnetic properties of iron was described some time ago to the Cambridge Philosophical Society by Mr. A. H. Peake. In this instrument a strong magnetic field is produced by sixteen bar magnets; this field, which is normally horizontal, may be slightly inclined at will by rotating a turn-table, to which the permanent magnets are attached, through a few degrees. The specimen of iron under test is very thin in proportion to its length; it is supported in a freely pivoted cradle, to which a control weight and a long pointer are attached; the axis of the cradle is in the same straight line with that of the turn-table.

HOW A PLANET IS WEIGHED.

BY FREDERICK R. HONEY, TRINITY COLLEGE.

In the measurements of astronomical distances, the unit of computation is the mean radius of the earth's orbit, i. e., ninety-two million nine hundred thousand miles. This unit multiplied a little over thirty times gives the radius of the orbit of the outermost planet, Neptune, nearly two thousand seven hundred and ninety-two millions of miles.

But the imagination is unable to grasp the meaning of these figures; and we are compelled to be content with the statement of the fact, without attempting to fathom its significance. When, however, we come to the consideration of volumes and weights, i. e., those of which we can speak with any degree of definiteness, the quantities appear to be, if not comprehensible, at least capable of being stated in terms of which we know something.

Simple illustrations are here given to make it possible for the average reader to understand the computations in the determination of a planet's volume and weight. These computations are dependent upon a knowledge of its apparent diameter; its distance from the earth; the radius of the orbit of one of its satellites; and the period of the latter, or the time of one revolution round the planet. Therefore the degree of accuracy is primarily dependent upon the ability of the observer to determine these elements.

We will take for our illustration the giant of our system, Jupiter, whose weight is about two and a half times the sum of the weights of all the other planets and their satellites. We will compare the volume and weight of Jupiter with those of the earth.

Jupiter's Volume.—In order to determine the dimensions of a planet, its distance from the earth and apparent diameter must be known. Jupiter's mean distance from the sun is 5.2 times the mean distance between the earth and the sun, i. e., over four hundred and eighty-three millions of miles. At opposition the mean distance between the earth and Jupiter is the difference between this distance and the mean radius of the earth's orbit, or about three hundred and ninety millions of miles. But on account of the eccentricity of the planet's orbit, this distance varies between very wide limits. When it is known, and the apparent diameter of Jupiter measured, his real dimensions may be computed. The equatorial and polar diameters of Jupiter are respectively 88,200 miles and 83,000 miles. The difference between these dimensions is apparent even in the accompanying small drawing (Fig. 1) which is an ellipse, the minor axis $a b$ representing the axis of rotation of the planet, and $c d$ its equator. Jupiter's volume is equal to that of a sphere whose diameter is 10.916 times the diameter of the earth.

Since the volumes of spheres are in proportion to the cubes of their diameters, Jupiter's volume is $10.916^3 = 1300.8$, i. e., thirteen hundred times the volume of the earth.

Jupiter's Weight.—Fig. 1 represents Jupiter and one of his satellites, Callisto, which revolves at a distance of one million one hundred and sixty-seven thousand miles from the planet; and completes her revolution in sixteen days and sixteen and a half hours. On the same scale the earth and moon are represented; the latter revolves round the earth in twenty-seven days and seven and three-quarter hours, at a mean distance of 238,840 miles. It should be noted that in the drawing, Jupiter, Callisto, the earth, and the moon are correctly proportioned, also the orbit radii of the satellites; but the latter are in each case made one-third of the length which would correspond with the dimensions of the planets and satellites, in order to bring the illustration within the limits of the paper.

Assuming that the satellite situated at M (Fig. 2) moves for a short distance in a circular orbit MM' round the planet at E, were it not for the force of gravity, it would travel in the direction of the tangent, and after a certain interval of time reach the position M''; and the distance which the satellite "falls" toward the planet under the influence of gravity is equal to the difference between the length of the hypotenuse of the right triangle EM'' and the radius EM'.

In order to institute a comparison between the orbits of the moon and Callisto, they are represented as having a common center at E; and for the purposes of this illustration, are for a short distance assumed to be circular. The length of the radius of Callisto's orbit is nearly 4.89 times that of the moon. Since Callisto travels in her orbit eight times as fast as the moon, the tangent CC'' is made eight times the length of the tangent MM''. The proportion between the distances $C''C'$ and $M''M'$ represents the attractive force of Jupiter upon Callisto as compared with that of the earth upon the moon.

By means of the very simple computation indicated above, we discover that $C''C'$ is about 13.1 times the length of $M''M'$, i. e., the attraction of gravity is more than thirteen times greater in one case than the other. But Callisto's distance from Jupiter is equal to nearly 4.89 times the distance between the moon and the earth. Remembering that the force of gravity diminishes as the square of the distance, the attraction represented by 13.1 must be multiplied by 4.89^2 in order to ascertain the attractive force of Jupiter as compared with that of the earth reduced to the same distance from the planet.

Multiplying these numbers, $13.1 \times 4.89^2 = 313.1$, i. e., Jupiter's attractive force, and therefore his mass or weight, is three hundred and thirteen times that of the earth.

If we divide this number by that representing the volume $\frac{313}{1300} = 0.24$, we obtain the density. A given volume of Jupiter therefore weighs a little less than a quarter that of an equal volume of the earth.

In the illustration (Fig. 2) the measurements CC'' and MM'' are very much exaggerated in order that the "fall" of the satellite toward the planet may be apparent to the eye.

The measurement contemplated is one which in the drawing would apparently coincide with the orbit.

The work more accurately in detail is as follows: Dividing the mean radius of Callisto's orbit by that of the moon, $\frac{1,167,000}{238,840} = 4.88 +$. The periods of the satellites reduced to minutes are respectively 24,032

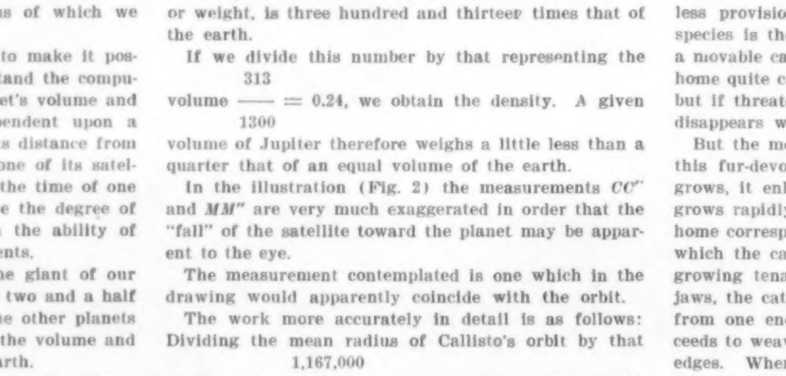


Fig. 1.

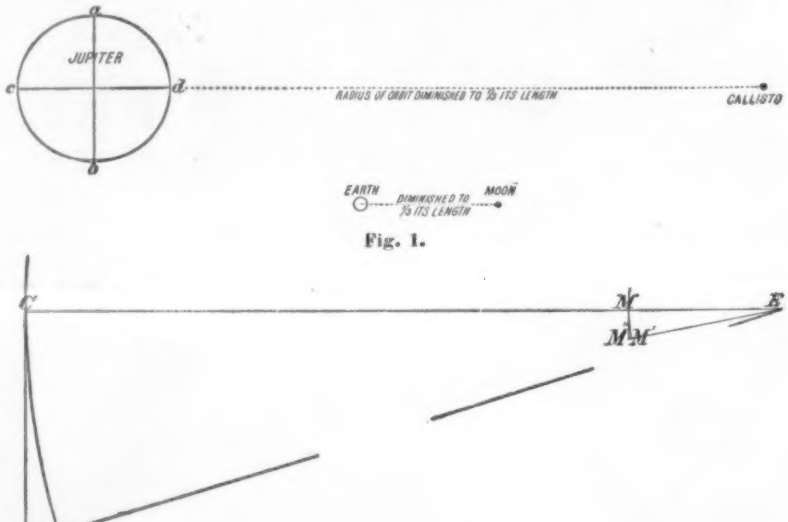


Fig. 2.

HOW A PLANET IS WEIGHED.

and 39,343; and $4.886 \times \frac{39,343}{24,032} = 7.999$, i. e., Callisto travels eight times as fast as the moon. We will suppose that the moon travels a distance of one mile in the direction of the tangent to her orbit. Her "fall" toward the earth is equal to $\sqrt{238,840^2 + 1} - 238,840 = 0.00000209345$ fraction of a mile.

While the moon is moving this distance, Callisto travels eight miles, and her "fall" toward Jupiter is equal to $\sqrt{1,167,000^2 + 8^2} - 1,167,000 = 0.00002742074$ fraction of a mile.

Dividing Callisto's "fall" by the moon's $\frac{0.00002742074}{0.00000209345} = 13.098$; and $13.098 \times 4.886 = 312.7$.

By this simple and direct process of how a planet may be weighed, we approximate within one and two per cent the latest computation of the weight of Jupiter.

A German engineer, Mr. Balderauer, of Salzburg, has proposed a method of using balloons for railway purposes, which is now being tested. A stationary balloon is fixed to a slide running along a single steel rail. This rail is carried up the side of a steep mountain, which ordinary railroads could not ascend, except by means of heavy inclines, with vast earthworks and tunnels. The balloon is moored by a steel cable to the rail, at a height of about 35 feet above the ground. The conductor can cause the balloon to ascend or descend at will. The lifting power is furnished by hydrogen gas, and the descent is caused by water pressure poured into a large tank at the upper end of the road. This is not so new as may be supposed. A similar method was described in these columns years ago.

Some Facts About Moths.

Some interesting information concerning the habits of the species of moth which cre such widespread havoc among domestic apparel h een furnished by a Scottish naturalist as the resul of his prolonged investigations. There are at least three common species of this destructive pest bearing the general name of "clothes moth," and all these differ somewhat in detail. The perfect insect, *Tinea Pellionella*, is about half an inch across the wings, the front pair of which are of a grayish yellow with three rather indistinct brownish spots on each, while the hind pair are whitish gray. The caterpillar, which is the real mischief maker, is of a dull whitish tint with a reddish brown head. This very destructive species is partial to furs, and the most valuable of such articles are liable to be sacrificed unless provision be made to resist its ravages. This species is the only one of the three which constructs a movable case or house. When moving, it carries its home quite comfortably along, as a snail does its shell, but if threatened with danger it shrinks together and disappears within.

But the most interesting feature in connection with this fur-devouring insect is the way in which, as it grows, it enlarges its home. As the little caterpillar grows rapidly both in length and girth, it enlarges its home correspondingly, and marvelous is the manner in which the case is adapted to the requirements of the growing tenant. First of all, by means of its sharp jaws, the caterpillar slits the case open longitudinally from one end for just half its length, and then proceeds to weave a strip of new material between the cut edges. When this is done the creature reverses its position, slits up the remaining half from the other end in the same manner, and inserts a little strip of freshly-woven material. By this means the diameter of the whole tube is increased, but hardly symmetrically. To preserve the original shape of the case, the insect repeats these operations on the opposite side. The lengthening of the tube is a simpler process, and merely consists of adding successive rings of material as required. But even in this case it is done at both ends alternately, and thus the original symmetry of the tube, which was slightly wider in the middle, is preserved. When the caterpillar has finished feeding, and incidentally done its maximum amount of damage, it prepares itself for the assumption of the quiet, harmless chrysalis state.

The Kattea: Are They Possible Aborigines of Africa?

An obscure race may possibly be the true aborigines of Africa south of the Zambesi. These are the Kattea—or Vaalpens, as they are nicknamed by the Boers, on account of the dusty color their abdomen acquires from the habit of creeping into their holes in the ground—who live in the steppe region of the North Transvaal, as far as the Limpopo. As their complexion is almost a pitch black, and their stature only about 1.220 meters (4 feet), they are quite distinct from their tall Bantu neighbors and from the yellowish Bushmen. The "Dogs," or "Vultures," as the Zulus call them, are the "lowest of the low," being undoubtedly cannibals and often making a meal of their own aged and infirm, which the Bushmen never do. Their habitations are holes in the ground, rock shelters, and lately a few hovels. They have no arts or industries, nor even any weapons except those obtained in exchange for ostrich feathers, skins, or ivory. Whether they have any religious ideas it is impossible to say, all intercourse being restricted to barter carried on in a gesture language, for nobody has ever yet mastered their tongue, all that is known of their language being that it is absolutely distinct from that of both the Bushman and the Bantu. There are no tribes, merely little family groups of from 30 to 50 individuals, each of which is presided over by a headman, whose functions are acquired, not by heredity, but by personal qualities. So little information is available concerning the Kattea that it is impossible to say anything about their racial affinities.

A series single-phase electric railway system between Atlanta and Marietta, Ga.—the first alternating-current line in the Southern States—was recently put into service. The line, which is of standard gage, is about 15 miles long, and is supplied with power from the hydraulic station of the Atlanta Water and Electric Power Company, 18 miles from Atlanta, transmission along the feeders being at 22,000 volts, with three-phase current. Each of the two sections of the line is served by two transformer sub-stations, these stations being a little more than three miles apart.

Correspondence.

Air Resistance.

To the Editor of the Scientific American:

In the September issue of the Scientific American, in the first article, "Air Resistance of Electric Cars," the figures for the flat front fall somewhat short of Smeaton's table of wind pressures, in which the square of the miles per hour is divided by 200 to find the wind pressure in pounds per foot; whereas in the article mentioned, for the rates 20, 60, and 80, the respective pressures are 1.4, 8.2, and 14 unit pounds. The ratios of $\frac{(20)^2}{1.4} = 286$, $\frac{(60)^2}{8.2} = 439$, $\frac{(80)^2}{14} = 457$ increase with the speed, but do not vary much between 60 to 80. I suppose the reason why these ratios are so much higher than in other tests, is that in the above tests the suction element was eliminated largely by the body of the car, both in deflecting the wind behind the flat testing front and by the eddy formed between the front of the car and the testing flat, which would tend to push forward on the latter.

I am interested in these experiments, as I am making some such tests for my own use. I think the above ratios in a free air test would come nearer 100.

Ira J. Paddock.

Percival, Iowa, September 6, 1906.

Aeronautic Terminology.

To the Editor of the Scientific American:

I was much interested in reading Mr. Joseph A. Blondin's letter in the issue of September 8, of the Scientific American. His classification of aeronautic terms (or rather that of the International Aeronautic Congress of 1889) is excellent as far as it goes; but aeronautics, as a science, is developing very rapidly, and it seems to me that the state of the art warrants a substitution for the term "aeroplane" (when applied to a complete machine) which is one of the three subdivisions of "aeronef" or "flying machine."

Properly speaking, an aeroplane *can only be one of the parts*, and not the whole, of an aeronef; for aeroplanes are used in kites, in soaring machines, and in *aerodynes*, which is the term I wish to propose to denote *aeroplane-supported machines, driven by mechanical power* (i. e., by a prime mover).

The Greek roots of aerodyne are obvious and expressive, and while I have always thought Langley's term of "aerodrome" was euphonious, it has been pointed out very properly by Capt. Ferber (Revue d'Artillerie, March, 1904) that "aerodrome" really means an *air course*, just as hippodrome means a course for horse races, etc., and in France "aerodrome" is also used to denote a balloon-shed.

The word *aerodyne* should be capable of international acceptance, and I would therefore suggest that in future the subdivisions of aeronef be: helicopter, orthopter, soaring machine, and aerodyne.

The term "flying machine" should be dropped, as it is too suggestive of the orthopter, or wing flapping device, to be synonymous with aeronef; and the term gliding machine (meaning soaring machine) should also be dropped from the nomenclature of aeronautics, as it is liable to be confused with the hydroplane or gliding boat, which is also a gliding machine.

W. R. Turnbull.

Rothesay, N. B., Canada, September 8, 1906.

"Vacuum Preservation."

To the Editor of the Scientific American:

I am much interested in Beatty's article on the vacuum process for preserving edibles. The Mason jar, so much used, is about as unsanitary as it can be. The fruit juices come into contact with the zinc cover around the porcelain lining of the same, and also between the zinc cover and the porcelain lining, making the lining useless. I have put up fruit in the West Indies, and on reaching home the zinc was corroded entirely through, and the contents of the jar had evaporated and spoiled. There is a number of jars on the market in which the contents only come into contact with a glass top and a rubber ring packing; these are sanitary, but for some unknown reason the price is more than that of the Mason jar. I have been a reader of the Scientific American for over half a century, and rejoice in the good work along such lines as this.

William B. Reed.

Hastings, Minn., September 9, 1906.

To the Editor of the Scientific American:

Referring to the series of inquiries in regard to vacuum preservation, I wish to say that such methods have been experimented on largely, and have been applied practically to a limited extent. A company in Philadelphia has for years been putting up an infant food in cans which are sealed under a vacuum of about twenty-eight inches. This preparation is a finely-powdered solid, among the constituents of which are dried egg-albumen and cereals. The conditions necessary for preservation of meat, ripened fruit, fruit juices, milk, and eggs are much more difficult to obtain, because these articles are always more or less impregnated with micro-organisms of sturdy vitality.

As you remark in your editorial comment, many of the questions asked by your correspondent cannot be answered without elaborate research; a few, however, can be answered from known data. The sterilizing effect of heat is due to the temperature almost entirely, and not to the pressure. If, therefore, water boils at, say, 120 deg. F., the fact of such boiling will not accomplish sterilization. A perfect vacuum is 30 inches only when the surrounding air-pressure is equivalent to 30 inches of mercury.

In the letter there is a statement which seems to me to mean that by mechanical means your correspondent obtained a vacuum equivalent to more than the surrounding pressure. This is impossible, and the observation has been evidently based on error.

Anaerobic bacteria may occur in any raw food product; some of them may be able to maintain their vitality for a long while under unfavorable conditions. Many persons overlook the fact that the simpler forms of life can remain long inactive without dying. Hence microbes live in ice for months; as soon as the ice melts and the temperature rises to about blood heat, the organisms begin to multiply. Satisfactory sterilization is not likely to be obtained by boiling under reduced pressure.

Henry Leffmann.

Philadelphia, September 10, 1906.

Motor-Boat Races on the Hudson River.

Some interesting races were held last week on the Hudson River under the auspices of the Motor Boat Club of America. The first day was given up to reliability trials. In these trials a number of the smaller boats competed. Points were given for different features, such as reliability, speed, condition after trial, economy of fuel, etc. The test consisted in making as many rounds as possible of the 10¼ nautical mile course within a given time. Several boats dropped out for various causes, such as stoppage of the water circulation, lack of sufficient fuel, etc.; but the two boats which made the best record were the "Simplex VI.," fitted with a 30-horse-power Simplex, four-cylinder engine, and the "Sparrow," another small speed boat under 33 feet in length and fitted with a 31.8-horse-power Packard four-cylinder, automobile motor. These two boats made eight and nine rounds respectively, and their best times were 41 minutes and 50 seconds, and 36 minutes and 28 seconds, the latter time corresponding to a speed of 19.43 miles an hour.

The second day's event consisted of a long-distance race from New York to Poughkeepsie and back, a total distance of 115⅝ knots, or 133.3 statute miles. Nine boats started in this event. These boats ranged from 60 to 30 feet in length, and carried engines of from 200 down to about 30 horse-power. Of the nine boats which crossed the starting line at the foot of West 112th Street at 9:30 A. M., but three returned late in the afternoon. The first of these to arrive was Mr. Harry Payne Whitney's large yacht the "Artful." This boat is some 60 feet in length, and is fitted with twin screws and two six-cylinder 6½ x 8 Speedway engines. She covered the course in 6 hours, 5 minutes, and 33 seconds, or at an average speed of 21.87 miles an hour. The next arrival was the 31-horse-power "Sparrow." This small craft, because of her fine lines and her reliable motor, was only 40 minutes longer than the "Artful" in covering the 133 miles. Her time was 6 hours, 45 minutes, and 55 seconds, corresponding to an average speed of 19.7 miles an hour. The third and last boat to finish was the 30-horse-power "Simplex VI." Her time was 7 hours, 43 minutes, and 59 seconds, which corresponds to a speed of 17.33 miles an hour. This was about 16 minutes slower time than that made last year by "Simplex III.," which won the race.

Wednesday, September 12, was given up to speed trials for mile and kilometer records, and also to a free-for-all race for the American championship. In the speed trials the "Standard," a large boat equipped with a new 300-horse-power, 10 x 10, six-cylinder, double-acting, Standard marine motor, made the fastest time. This boat covered a mile with the tide in 2 minutes and 10 seconds, and against the tide in 2 minutes and 34 seconds. The average figured out 25.56 knots, or 29.46 statute miles an hour. The next best mile record was made by the "Dixie," which is equipped with an 8-cylinder 6½ x 6¾ engine, rated at 132.72 horse-power. This boat made the mile with and against tide in 2:35 and 2:44 respectively, or at an average speed of 22.57 knots, or 26.01 miles an hour. The "XPDNC," fitted with Mercedes engines of 60.83 horse-power, made 22.22 knots, or 25.61 miles in the mile trial, and the "Mercedes U.S.A.," which likewise had a 60-horse-power Mercedes engine, made 19.09 knots, or 22 miles an hour. The "Vesuvius," a new boat fitted with a Hurd & Haggin engine of 40 to 50 horse-power, attained a speed of 20.64 miles an hour in a mile trial. The best records for the kilometer were 1:07 and 1:37 with and against tide, made by the 300-horse-power "Standard." This was an average of 1:22. By making this distance in 1:18 and 1:46 with and against tide, the 60-horse-power "XPDNC" attained the same average (1:32) for the kilometer as did the 132-horse-power "Dixie," which covered the distance in 1:23 and 1:41 respectively.

The free-for-all race for the American championship consisted in making three rounds of the 10¼ nautical mile course. But two boats succeeded in finishing this race. These were the 132-horse-power "Dixie" and the 190-horse-power "Skedaddle." The latter 60-foot boat had a 9 x 10, 6-cylinder, Craig engine. It did not succeed in making any extraordinary time, however. The race was won in 1 hour, 20 minutes, and 1 second by the "Dixie," while the "Skedaddle" required 1 hour, 44 minutes, and 39 seconds. The "Dixie" averaged 23.06 knots, or 26.58 miles an hour, in this race, which was 35½ statute miles in length. The second day after, the "Dixie" ran this distance for a third time in the race for high-speed boats of 12 meters (39.37 feet) length and under, in 1 hour, 19 minutes, and 6 seconds, thus making 23.39 knots, or 26.96 miles an hour. In the race for high-speed boats of 40 feet and over, the "Skedaddle" won in 1 hour, 27 minutes, and 49 seconds, which corresponds to an average speed of 21.01 knots, or 24.22 miles an hour. The following day she did somewhat better, covering the 35½ statute miles in 1 hour, 22 minutes and 10 seconds, and winning from the "Dixie" on time allowance, because of her lower rating. In the race for high-speed boats of 33 feet and under, the "Sparrow" won in 1 hour, 44 minutes, and 46 seconds, or at an average speed of 17.59 knots (19.27 miles) an hour. Her fastest lap was made in 34.19, or an average speed of 20.38 miles an hour.

The races were marred by an accident which occurred on Friday afternoon to Mr. L. L. Haggin's "Vesuvius," and as a result of which the two men who were running this boat were drowned. The "Vesuvius" had trouble with her steering gear, which suddenly gave way and caused her to swerve, thus precipitating one of the men into the river. The other man attempted to rescue him, and both were drowned. On the third day of the races the steering gear of the 300-horse-power "Standard" broke while she was making a sharp turn, thereby disabling her. These accidents seemed to show that builders of motor boats do not realize the tremendous strain put upon the steering gear of such craft when making sharp turns at high speed.

In the races which have just been held no remarkable records were made. The long-distance race was a fizzle, owing to the unreliability of the competing boats, and the time made by the winner was by no means comparable to the record run from Rouen to Trouville made recently in France by "La Rapiere II.," in which she covered the 70 miles between the two places in 2 hours and 9 minutes, or at an average speed of 32.9 miles an hour.

From the performances of the boats in this meet it would seem as if the present scheme of placing tremendous horse-power in a light hull has been pushed to its limit, and that in order to realize any increased speed, some new form of hull offering less resistance must be designed.

The Elimination Race for the Vanderbilt Cup.

On Saturday, the 22d instant, the elimination race to select a team of five machines and drivers to represent America in the Vanderbilt cup race of October 6 will occur on Long Island. The course used will be much the same as that traversed last year. It has been changed somewhat, so that the bad S turn will be avoided, but in place of it there will be a very sharp "hairpin" turn near Roslyn. The start will be near Mineola, as heretofore. The race will consist of ten circuits of the 29.7-mile course. Fifteen powerful cars are expected to compete. Among the entries are three Thomas machines, three Frayer-Millers, a Locomobile, a Christie, a Haynes, an Apperson, Oldsmobile, Matheson, Maxwell, Pope-Toledo, and a B. L. M. Most of these machines are specially-built racers of from 100 to 130 horse-power. Even if all do not start, there will be a sufficient number to make a most exciting and interesting event. The first five cars to finish will form the American team in the subsequent race.

The Current Supplement.

The current Supplement, No. 1603, is of more than usual interest. The new Morrison Street bridge at Portland, Ore., is illustrated and described. "Modern Manufacture of Alcohol" is the beginning of a specially translated treatise on this subject which is very much in the public eye at the present time owing to the passage of the free alcohol bill. The first installment deals with the chemistry of the subject. "Meteorites" is by Oliver C. Farrington and is illustrated by the most interesting engravings. "The Art of Inventing" is a most important article by E. J. Prindle. Among the other articles are: "Large Electric and Steam Locomotives," "The Queen Ant as a Psychological Study." "Clearing New Land" is concluded. "Malleable Cast Iron" describes an important process. The usual notes will be found in this issue.

THE PIONEERS OF THE SWISS ARMY.

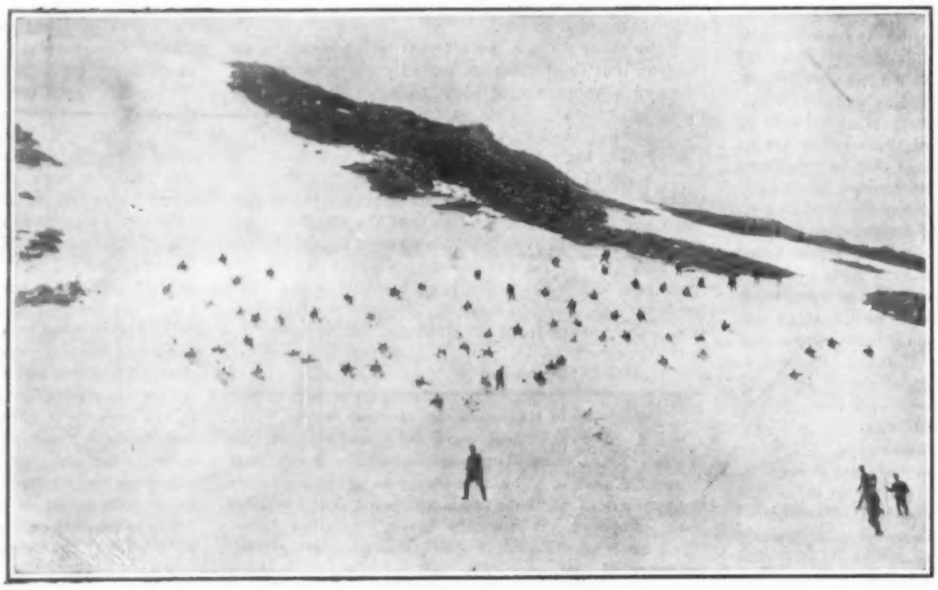
BY DAY ALLEN WILLEY.

While all of the European countries whose boundaries extend to the "backbone" of Europe have divisions of their armies composed of troops trained especially for maneuvers among the mountains, the Swiss soldier probably excels all others as an Alpinist; nor is this strange, when it is remembered that practically all of this little republic is situated in the heart of the Alps, and much of it is above the cloud line.

In a country where the highway may lead over summits 10,000 feet above sea level, where glaciers may be more easily crossed than the ordinary road, special instruction in mountaineering is absolutely necessary as a branch of military tactics. Hence the Swiss soldier is as familiar with the alpenstock as he is with his rifle, and moves about on skis as quickly and skillfully as the Swede or Norwegian. While numerically the Swiss army is relatively large, consisting of over 150,000 men, including all branches of the service, its mobility as a fighting unit is really remarkable. Some of the feats which are performed by the various commands are notable, because they would be impossible for soldiers in other portions of Europe.

During winter as well as summer the Swiss soldier frequently journeys from post to post over the snow-filled passes among the higher Alps, as already stated, frequently crossing glaciers and snow fields of great extent. In descending a mountain, glissading with the aid of skis is common. Tourists in Switzerland sometimes witness the novel sight of an entire battalion sliding down an incline at great speed, yet without a man losing his balance. At the end of the glissade each soldier immediately takes his place in the ranks, ready for the march.

So much has been written and said of the prowess of the tourist guides in Switzerland, that the ability of the soldier in climbing difficult peaks is comparatively little known. In executing certain orders the men are sometimes required to climb mountain slopes where the ice ax and the rope are absolutely necessary, but in addition to these appliances they must carry their rifles, possibly haversacks as well, thus making the ascent even more difficult and perilous.



Descending a Mountain Side on Snowshoes.

As may be imagined, engineering work from a military standpoint forms a most important part of Alpine tactics. One work of the engineer is the construction of pontoon bridges of suitable size and strength to permit the passage, not only of foot soldiers, but of cavalry, if necessary, and even of field artillery. When it is remembered that the mountain streams of this country are notable for their swift current and the rapid rise and fall in the volume of water, it will be recognized that the task of the engineer is far more arduous and hazardous than in the lowlands, where the streams to be crossed have comparatively little velocity. Bridge building, however, is a part of the maneuvers frequently carried out. The pontoons, mere flatboats, are arranged obviously according to the strength of the current and the depth of the water. At times it is necessary to place them but a few feet apart; but if the current is not too strong, they are anchored at distances ranging from ten to fifteen feet of each other, the bows of course pointing up stream, securely anchored by heavy weights. As fast as the pontoons are secured, longitudinal timbers are laid across them. These "balks" are secured in place by rope lashings made fast to cleats in the pontoons, sometimes by means of bolts or pins which can be quickly adjusted. The beams average about five inches in thickness and are made of seasoned timber, so that they are not affected by dampness or the weather. Upon them is placed the flooring of the bridge, consisting of planks ranging from one inch to one and one-half inches in thickness and measuring about a foot in width. It is a fact that no nails whatever are used in fastening the planking to the beams, the fastening being done by rope lashing, so that the superstructure of the bridge can be taken apart immediately after the troops have crossed. Side rails, laid along each end of the flooring and lashed directly to the pontoons, act as a reinforcement to the strength of the structure.

Such a bridge will support a weight of at least one hundred pounds to every square foot. The width depends upon the size of the stream and the number of men, but usually the Swiss bridges do not exceed ten feet in width, permitting the passage of infantry in columns of fours, as well as batteries and field pieces drawn by horses. The pontoons are also utilized independently of bridge work for crossing the mountain streams, especially in moving artillery. The gun is detached from the carriage, and the equipment loaded aboard the boat. A squad of artillerymen then man it, and the horses for drawing the gun carriage and caisson are forced to swim across, being held by some of the men in the pontoon. Thus the Swiss soldier is drilled not only in Alpine work, but as a waterman, for it is frequently necessary to cross rivers at points where there are no permanent or temporary bridges, and the use of the oar is as essential as the use of the alpenstock.

The Canadian Pacific Railway offers a 12,000-mile trip under one flag.

Crossing a Pass in the Alps.

Assembling Pontoons.

Fording a Stream.

THE PIONEERS OF THE SWISS ARMY.

A PECULIAR RUPTURE.

BY W. D. GRAVES.

The accompanying photograph is of a short section of a flue taken from an old boiler, and shows two small holes which appear to have been made by some pressure from the inside of the flue, i. e., a pressure from the direction opposite to that of the normal steam pressure.

Though the direction of the rupture is more distinctly apparent in this place than in any other, it is only one of several similar holes in the same set of flues. The boiler was used in connection with a 2-horse-power engine, under a pressure of 60 to 80 pounds, and this set of flues had been in only a year. The photograph is of a part near the center of one of the latter.

The only explanation of the peculiar rupture which seems applicable is that it must have occurred from the inward pressure of the air when the boiler had cooled sufficiently to form a vacuum. The appearance would indicate that the scale had served to help withstand the steam pressure, while against that from the outside it offered little or no resistance.

The circumstances support this theory as to the cause, in that the boiler was last fired on a very cold evening, cooled off rather more quickly than usual, and was found, the next morning, to leak freely.

A PECULIAR RUPTURE.

A MANTEL MADE OF CIGAR BOXES.

The accompanying illustration is manifestly a picture of a carved mantel. It is more than that, however. It is made of cigar boxes, two thousand in number, and nothing but cigar boxes. The man who presumably smoked the cigars contained in the boxes (or at least obtained the cigar boxes of other smokers) carved all the ornamentation with a penknife during his leisure time. That is why three years were consumed in the operation.

AN OVERMANTEL MADE FROM 2,000 CIGAR BOXES.

Only cigar boxes were used, and all the carving was done by hand with a penknife during the leisure moments of a workingman's time. The work was completed in three years.

A CURIOUS ACCIDENT TO A GRAIN ELEVATOR.

BY W. F. MINERS.

One of the most peculiar accidents which might befall a modern grain-handling plant occurred at Fort William, Ont., recently when the gigantic elevator of the Ogilvie Milling Company slid from its foundation into the Kaministikwia River in much the same manner as a vessel leaves her ways on being launched.

The structure, which cost $250,000, was of the tubular steel type, 60 feet wide, about 100 feet long, and 180 feet high, built on a concrete foundation, which was supported by 65-foot piling driven through clay to solid rock. The elevator had a storage capacity of 500,000 bushels, and contained about 400,000. It was built but two years ago, and was one of the most modern grain-handling plants on the continent, it being electrically operated throughout, induction motors supplying the motive power

It is generally believed that defective concrete work was the cause of the accident. The cement foundation was 16 feet high and only 16 inches in thickness, which it is now claimed was not sufficient to withstand the enormous weight. The foundation gave way at one corner, and the whole wall immediately went to pieces, letting the building slide 30 feet into the river. The structure at the time the accompanying picture was taken stood in 20 feet of water at an angle of 25 deg. It was a total loss, as the tanks were twisted and pulled completely out of shape. Holes were tapped in the sides of the tanks, and the wheat run off through these openings into scows in the river below, from which it was transferred to boats, about 50 per cent of the grain being lost.

A GRAIN ELEVATOR WHICH GLIDED INTO A RIVER AFTER ITS FOUNDATION FAILED.

Scott's Discoveries in the Antarctic.

Great Britain may well be satisfied with the information collected in the Antarctic by Capt. R. F. Scott and his gallant companions. The full results of the scientific observations are not yet worked out, and in many cases for a complete appreciation of their bearing they must be compared and correlated with those of the other Antarctic expeditions, but many highly suggestive points have already been revealed. And what did Capt. Scott find after his memorable struggle up the glacier through the mountains? An enormous plateau at an elevation of about 9,000 feet, nearly level, smooth, and featureless, over which he traveled directly inland for over 200 miles, seeing no sign at his furthest point of any termination or alteration in character. So far as could be seen from other journeys, glacial discharge from this great upland is very small, and practically it appears to be dead. Its accretion by fresh snow-fall is insignificant, while on all sides along the flanks of the coastal mountains there are signs of diminution in the mass of ice. The great ice-barrier east of Ross Island tells the same tale. This magnificent feature presents to the sea a face of perpendicular ice-cliffs varying from 60 feet to 240 feet in height, and 450 sea miles long. Sir J. Ross mapped its position in 1841, and Capt. Scott finds that it has retreated on an average fifteen miles, varying much in different parts. Should this rate of retreat continue the whole of this ice mass, as far as Capt. Scott saw it, will have vanished in 1,000 years. As the motion of the ice mass is about fifteen miles to the north in the same time, icebergs covering collectively an area of 450 miles by 30 have been discharged from it in sixty years. Capt. Scott traveled over it nearly due south to a point 300 miles from its face, and then saw no sign of its end. It is bordered on its western side by a mountainous coast line, rising in places 15,000 feet. He found the ice practically flat and wholly unfissured, except at the side, where its northerly motion, found to be about 130 feet in the month, caused shearing and vast crevasses. All that is known of its eastern edge is that it is bordered, where it meets the sea, by land from 2,000 feet to 3,000 feet high, suspected by Ross and verified by Capt. Scott. This may be an island, or more probably the eastern side of the great fiord or bay now filled by the barrier. Capt. Scott is of opinion that this great ice sheet is afloat throughout. It is unexpected, but everything points to it. From soundings obtained along the face it undoubtedly has about 600 feet of water under it. It is difficult to believe that this enormous weight of ice, 450 miles by at least 360, and perhaps very much more, with no fall to help it along by gravity, can have behind it a sufficient force in true land glaciers to overcome the stupendous friction and put it in motion if it be resting on the bottom. It is sufficiently astonishing that there is force enough even to overcome the cohesion at the side, which must be very great. The flat nature of the bottom of the Ross Sea and the analogies of many geographical details in other parts of the world make it most probable that the water under the whole barrier is deep. A point on which no comment has been made is the difference in the appearance of the slopes of Mount Terror. Capt. Scott found the bare land showing over large areas, but during the two summers of Ross's visit it was wholly snow-clad. Sir Joseph Hooker, the sole survivor of Ross's expedition, when questioned had no doubt on the subject, and produced many sketches in support. This may be due to temporary causes, but all the information collected by the expedition points without doubt to steadily diminishing glaciation in recent times. We have, therefore, this interesting fact, that both in Arctic and Antarctic regions, as indeed all over the world, ice conditions are simultaneously ameliorating, and theories of alternate northern and southern maximum glaciations seem so far disproved. But this does not mean that climatic conditions in the Antarctic are now less severe—probably the contrary. It has been pointed out by many that land glaciation may arise from varied primary causes, but one obvious necessity is that the snowfall should exceed melting and evaporation. It need not be heavy; but if it is it may produce glaciation under somewhat unexpected conditions. This would entail a vapor-laden air more or less continuously impinging upon the land at a temperature which will enable it when cooled, either by passing over chilled land or when raised to higher regions by the interposition of mountains, to give up its moisture freely. This condition is not fulfilled when the air as it arrives from the sea is already at a very low temperature. The shores of the whole of western southern Patagonia, deeply indented with long and deep fiords, indicate, according to all received views of the origin of such formations, that the land was formerly higher, while signs of glaciation are everywhere present.

A Needed Machine.

An illustration of the difficulty of making a practical machine in which the government is vitally interested is the postage-stamp sticking machine. According to Machinery there is no practical machine for sticking postage stamps on letters, although the demand for such a machine is considerable. The difficulty of the problem lies in the fact that postage stamps come in sheets gummed and perforated. A stamp sticking machine should, of course, have the stamps printed in strips which should not be perforated but should be slightly notched on each side at the junctions of adjacent stamps. With the stamps prepared in this manner the problem of a successful sticking machine becomes a comparatively simple one, but where the invention is restricted to the use of stamps in the present form the difficulties are so great as to make the scheme in all probability impractical. To get the government officials to print stamps in strips and supply them rolled, ready for use in such a machine, would require great political and business influence and pressure and is something that would certainly cause a very great scandal on account of appearing to favor a patented device which must necessarily be a monopoly.

THE MINNEQUA WORKS OF THE COLORADO FUEL AND IRON COMPANY.

BY LAWRENCE LEWIS.

Ten per cent of Colorado's population, it has been estimated, is dependent upon wages earned by employees of

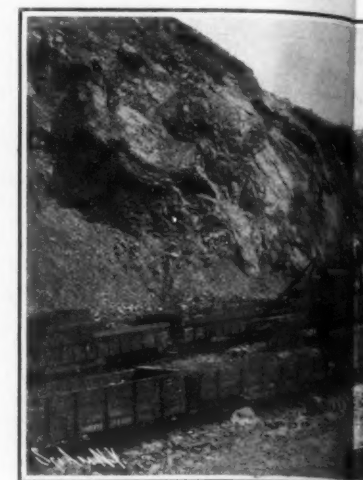
Pimero, Colorado: the Largest Coal Camp of the Colorado Fuel and Iron Company.

the Colorado Fuel and Iron Company, which is engaged in the mining of iron ore and coal, together with the production of coke and all sorts of iron and steel products, although the mining of precious metals is generally supposed completely to overshadow all other industries in that State.

Filling Molds from Bottom of 50-ton Ladle at Open-Hearth Steel Plant.

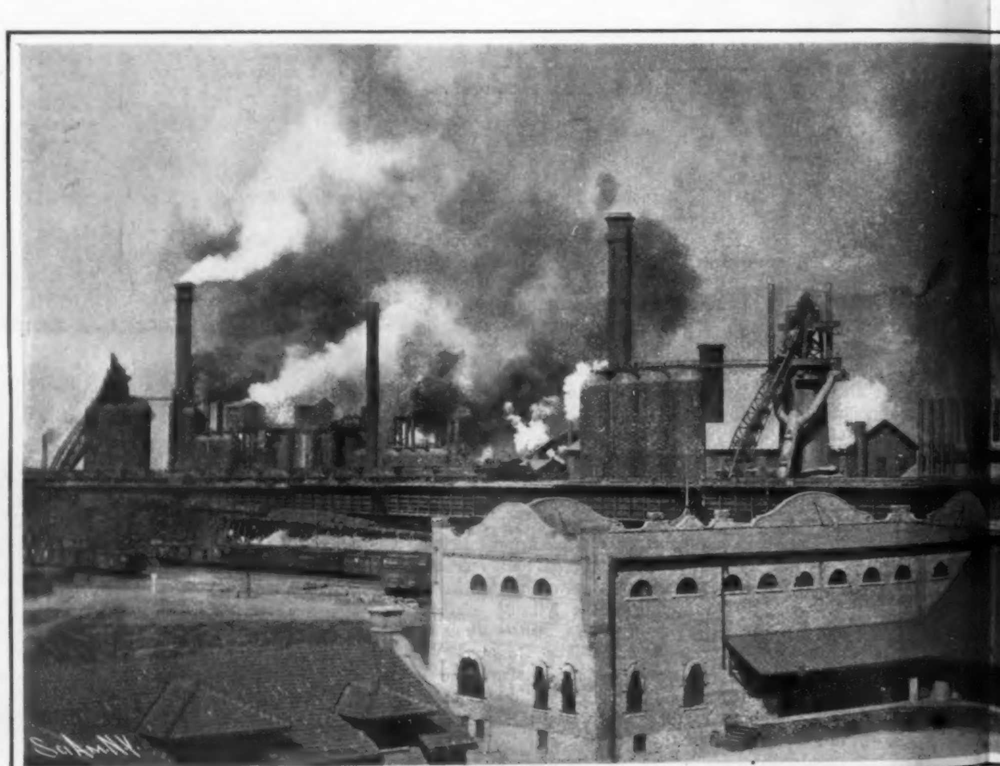
In 1891 the Colorado Fuel and Iron Company was represented by a small and unimportant steel plant at Pueblo, worth about $3,000,000, the chief product of which was steel rails that only partly supplied the requirements of the local market. The phenomenal growth of the plants is shown by the fact that at present the Minnequa Works of the Colorado Fuel and Iron Company is one of the largest iron and steel plants of America, representing the investment of over twenty-five millions of dollars, employing between four thousand and five thousand men, and producing a wide variety of products.

The history of the steel plant at Pueblo is that of the iron and steel industry west of Chicago. The Colorado Coal and Iron Company built a single small blast furnace and began to "make" pig iron during September, 1881. The first Bessemer steel was made in the small converter the following April. A puddle mill, cut-nail mill, bolt mill, merchant mill, and rail mill—all of small capacity—were soon added, and in 1889 a second small blast furnace. Ore came from small iron mines at Orient, the fuel from a few small coal mines and banks of coke ovens in "the southern field" near Trinidad and in Gunnison County on "the western slope." The extensive development of the Pueblo plant and of the iron and fuel industry in the West did not, however, begin until after August, 1892, when the capitalists at the head of the Colorado Fuel Company, the Grand River Coal and Coke Company, and the Huerfano Land Association took charge of the iron works. October 21, 1892, a merger of these last-named companies and of the Colorado Coal and Iron Company was effected under the name of "The Colorado Fuel and Iron Company." The fuel properties were first extensively developed, and upon the revival of business following the depression of 1893, the steel plant was improved and slightly enlarged. Rapid enlargements did not begin, however, until 1900, since which time the original departments have been increased several times in size and almost completely rebuilt and many new mills have been added. The capital stock was increased in October, 1904, from $40,000,000 to $46,200,000, to provide among other things for improvements made shortly thereafter at the Minnequa Works where now there is being spent in addition some four million dollars. A tract a mile long and half a mile wide is now covered by mills and trackage of the Minnequa Works, and an even larger area—including sites for proposed new mills and ground used for storage—is surrounded by the "mill fence." The plant now in operation includes two old, but recently rebuilt, and three larger blast furnaces erected since 1900, with a fourth under construction. Each of the larger furnaces is 20 feet in diameter by 95, 90, and 85 feet in height respectively, with an average daily capacity of 400 tons. The Bessemer steel department is equipped with two 15-ton vessels; two 300-ton molten metal storage tanks, which are served by two 50-ton electric traveling cranes; three 10-foot iron cupolas; three 7-foot spiegel cupolas; two Aiken duplex hydraulic ingot strippers.

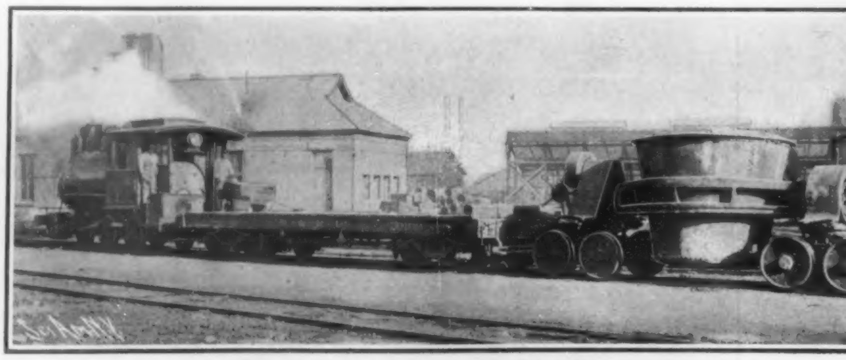


Steam Shovel Loading Ore from Op[en] Cut

The open-hearth steel department consists at present of six stationary basic furnaces, each of fifty tons capacity, 60 feet 6 inches by 17 feet in size, in addition to which six additional basic furnaces and a 300-ton molten metal storage tank are now being added. The new main building will be 1,005 x 200 feet. Ingot stripping is performed by two Aiken duplex hydraulic strippers. Gas is supplied by forty-eight large-size water-seal Duff producers. The 2-high 40-inch blooming mill in which the O. H. ingots are reduced to 4-inch billets, is driven by a 55 x 60-inch



General View of a Part of the Bla[st Furnaces]



Pot Car for Carrying Slag from the Blast Furnaces.

Erecting One of the Blowing Engines for ... Furnaces.

THE MINNEQUA WORKS OF THE COLORADO ...

double reversing engine coupled direct to the mill. Two shears, one hydraulic and one driven by a vertical engine, cut the product. The five pit-heating furnaces for this blooming mill are served by two 5-ton automatic charging and drawing cranes. A roller conveyor about 900 feet long distributes the blooms and billets to the rod mill and storage yard.

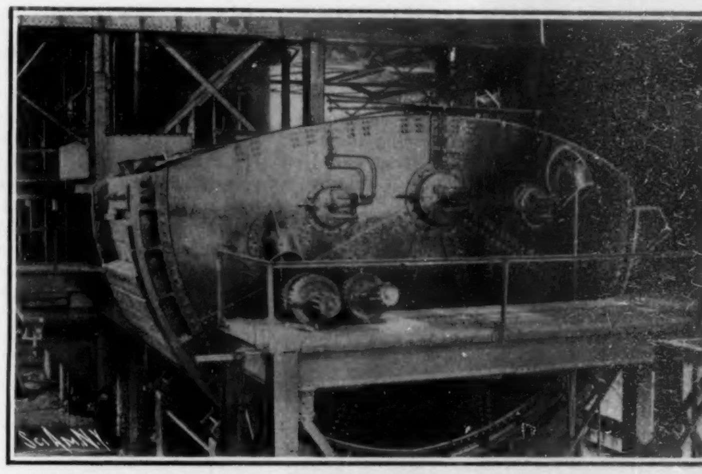
rom Open Cut to Cars at Sunrise Iron Mines.

The roll trains of the rail-mill, which is practically all new, are covered by a steel main building 55 feet x 580 feet. The hot-bed building is 121 feet 6 inches x 174 feet. The building covering the finishing department is 774 feet x 60 feet; that covering the soaking pits, 89 feet x 166 feet. The ingots, when taken from the soaking pits by two electric automatic charging and drawing cranes, are deposited in an automatic tilting car which conveys them to the blooming table. Gas used in this department is supplied by twelve Duff producers.

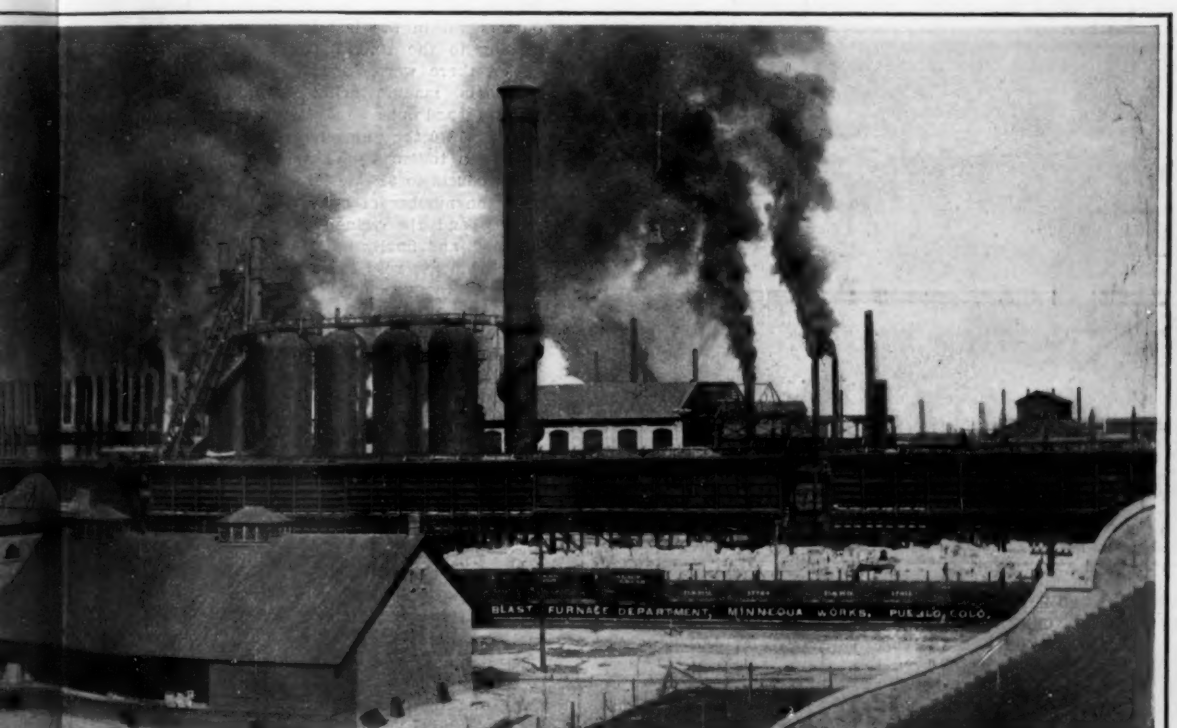
The double Garrett rod mill is practically of the standard type, the only difference being the location of some of the rolls. The 16-inch continuous mill and the 14-inch train are driven by a 40 and 72 x 60 inch tandem compound engine. The three 10-inch trains of each mill are driven by a 38 and 70 x 48 inch and a 27 and 46 x 42 inch cross compound engine. Four Laughlin furnaces heat the billets in 6-foot lengths. All the engines and rolls are covered by electric overhead traveling cranes. The main building of the rod mill is 137 feet by 534 feet. The furnace building is 90 by 126 feet.

The wire mill is one of the largest and most complete in America, being thoroughly equipped in every detail to manufacture all sorts, shapes, and sizes of wire and wire product. There are 360 blocks in the wire-drawing department; 280 machines in the nail department, with an approximate total capacity of 6,000 kegs in twenty-four hours; 81 machines in the barb-wire department, with an approximate total capacity of 150 tons in twenty-four hours. The wire mill is fully equipped with cleaning, annealing, painting, and dipping departments, repair shops, independent electric plant, rumbling department, and other accessories. For supplying the wire mill and other departments with kegs, the company has a cooperage shop with a capacity of 5,000 to 8,000 kegs every ten hours. Staves and headings come from sawmills, etc., operated by the company on its timber lands near Little Rock, Ark.

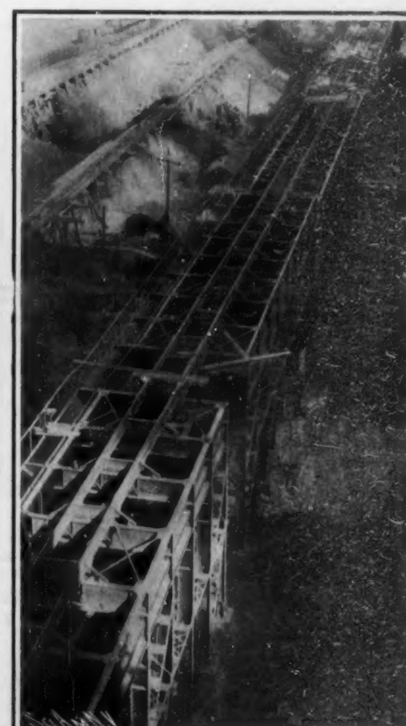
In addition to the new mills described above, the Minnequa Works includes a merchant iron department comprising 9, 12, and 20-inch mills for miscellaneous shapes and comparatively light tonnage; spike, bolt, and nut factories complete in all details; iron, steel, and brass foundry; cast-iron pipe foundry; complete electric power plant for supplying all departments except the wire mill. The approximate capacity of the several departments now in operation is as follows: Blast furnaces, 2,000 tons daily; Bessemer steel department, 2,000 tons daily; open-hearth steel department, 1,500 tons daily; rail mill, 1,500 tons daily; 40-inch blooming mill, 1,200 to 2,000 tons daily; rod mills, 600 tons daily; wire mill, 700 tons each twenty-four hours; 9, 12, and 20-inch mills, from 200 tons to 250 tons daily, varying with size of shapes; cast-iron pipe foundry, about 40 tons daily; bolt and nut factory, 500 tons per month; spike factory, 80 tons per day.



Metal Storage Reservoir, Into Which Molten Metal is Poured from the Pot Cars.



Part of the Blast Furnaces of the Minnequa Works.

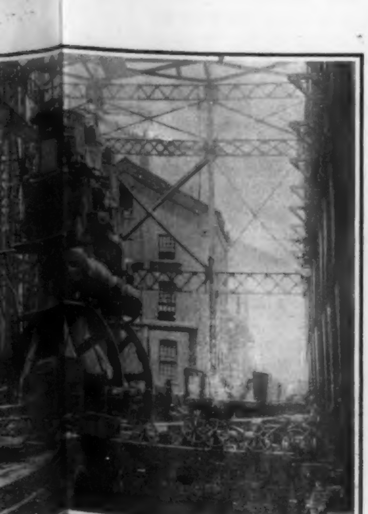


Bird's Eye View of Coke, Ore, and Limestone Bins.

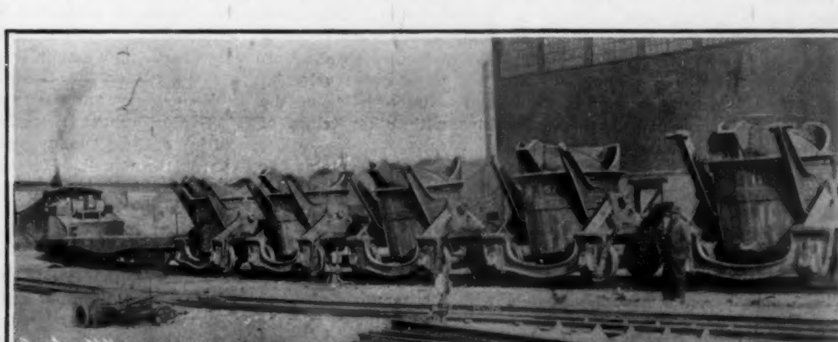
During the year ending June 30, 1905, the Colorado Fuel and Iron Company produced 4,504,752.65 tons (2,000 pounds) of coal; 948,553.50 tons of coke; 483,570.86 tons of iron ore; 213,007.36 tons of limestone; and 1,444,177.19 tons of iron and steel and iron and steel products.

A perfectly reliable water supply is as essential to the operations of an iron and steel plant as is ore or coke. The Colorado Fuel and Iron Company has therefore taken the precaution to fortify itself well against a failure of water. It has completed reservoirs Nos. 1, 2, and 3 near Pueblo, having a total storage capacity of 3,000,000,000 gallons, besides two additional "sugar-loaf reservoirs" near Leadville, at the sources of the Arkansas River, which brings the total storage capacity up to 10,000,000,000 gallons.

Like the original Carnegie Steel Company, the Colorado Fuel and Iron Company owns or controls sources for all its raw materials including



wing Engines for Supplying Air to the Blast Furnaces.



The Molten Metal is Carried in These Pot Cars from Blast Furnaces to Converter or Open-Hearth Furnaces.

THE COLORADO FUEL AND IRON COMPANY.

iron lands in Colorado, Wyoming, New Mexico, and Utah; some 600 square miles of the finest coal—anthracite as well as coking and non-coking bituminous—one tract being 250,000 acres in extent, all easily accessible from the steel plant; limestone quarries, manganese mines, etc. It has 39 coal mines and 3,500 coke ovens—a majority of them being of the "beehive" type, for there is no market for by-products sufficient to warrant the use of by-product ovens, which are comparatively very expensive, and against which there is prejudice because of the contention of some experts that the quality of coke produced from western coal in by-product ovens is inferior. Including those not yet thoroughly opened, the Colorado Fuel and Iron Company has in various parts of Colorado, Utah, New Mexico, and Wyoming, 65 properties scattered over an area of 260,000 square miles.

Fundamental differences exist between the problems of development in the Rocky Mountain region and those confronting iron and fuel corporations in the middle West. In the latter region, when development of the coal and iron resources was begun on a large scale, means of transportation were to a great extent already provided, or by the construction of short spurs of railroad and the utilization of natural waterways, raw materials could be transported to the steel works and the market at comparatively small cost and without great preliminary expenditure. Again, in the comparatively thickly-populated middle West, the securing of labor near at hand is possible and, to a great extent, places for workmen to live are already provided near the seats of industry. In the Rocky Mountain region, the pioneers of the iron and fuel industry found no such ready-made conditions. In the field which the Colorado Fuel and Iron Company operates there are no navigable lakes or rivers. To reach new properties railroads had to be induced to extend or the company had to build its own lines. It now operates 178 miles of railroad, and has supplemented existing lines of electric communication by 1,835 miles of telegraph. In fact, in a majority of cases, where the "prospects" have been in the midst of the desert or far off in "the hills," the company has had, in addition to the task of opening mines and providing means of transportation, those of building towns, of providing people to live in them, and of supplying water, food, and merchandise. In short, besides the ordinary problems of coal and iron mining, coke and steel making, the Colorado Fuel and Iron Company has had to solve those of general development.

Some 17,000 men, representing between twenty and thirty nationalities, are now employed by this corporation. Between 4,000 and 5,000 are employed at the steel plant.

The Colorado Fuel and Iron Company's principal source of iron ore is the Sunrise group of mines in Laramie County, southern Wyoming, 360 miles from the steel plant on the Colorado & Southern and the Burlington and Missouri River railways. The open-cut system of mining with steam shovels, which was the principal method employed earlier in the history of this property, is now largely replaced by the "milling" system of underground mining, the product being handled through shafts and tunnels. There are also smaller iron mines at Orient, Colorado, and Fierro, N. M. In the open-cut work the ore is loaded directly from the steam shovel into standard-gage railroad cars. In the underground work the ore is dumped from skips and mine cars into bins, from which it is drawn off into the automatic dump cars, in which it is carried to the steel works and dropped into the ore bins at the furnaces.

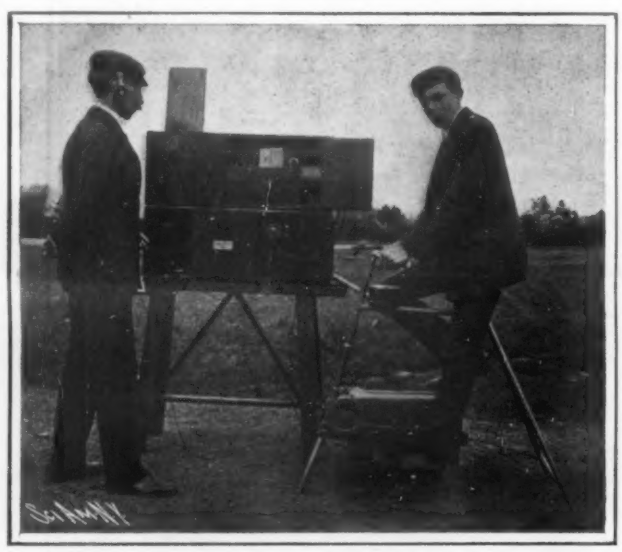
On a track beneath these bins run electric trolley "scale cars," into which are drawn from the bins, in proper proportions by weight, the coke, limestone, and ore to make up the "charge" for the blast furnaces. The contents of the scale cars are in turn automatically dumped into the "skip cars," which run up a "bridge" on the side of each blast furnace, and automatically drop their contents into the "upper bell"—a cone-shaped receptacle at the top of the blast furnace. Then this upper bell is lowered, allowing the charge to drop upon the lower bell, whereupon the upper bell is again raised. Next the lower bell is lowered, and the charge drops into the fiery interior of the furnace. The slag and molten iron are drawn off into immense pot cars.

The slag is hauled over a short railroad to one of the reservoirs three miles south of the plant, where it is dumped while still molten upon the sides and bottom. By this ingenious arrangement the problem of slag disposition is solved, and the seepage from the reservoirs reduced.

The molten iron is hauled either to the pig-casting machines or to the metal storage reservoirs at the open-hearth and Bessemer steel departments where it is kept in a molten state and drawn off as required in the furnaces or the "converter." After the impurities in the form of silicon, carbon, manganese, sulphur, and phosphorus have been to a greater or lesser extent eliminated by these processes, the molten steel is drawn off and cast into ingots. After these are stripped from their molds they are taken either to the 40-inch blooming mill, where they are reduced to 4-inch billets and then worked into the other highly differential products, or else are taken to the rail mill and rolled into railroad rails. Although at the Minnequa Works the Bessemer process will always be a very important feature, it is likely, owing to the chemical constituents in the ore found in the new deposits of the company now being opened, that the open-hearth process will become more and more important.

Throughout all processes of mining and steel making the company uses the most improved labor-saving machinery. Indeed, from the time the ore lies in the earth until it is put into its final form as finished iron or steel, it is in many cases not handled over once or twice by manual labor, but altogether by automatic machinery.

That the Colorado Fuel and Iron Company is one of the few steel companies not a constituent part of the United States Steel Corporation, and that it operates the only large steel plant west of the Chicago district, are features that have important bearings upon the company's place in the iron trade. It is, moreover, absolutely independent of competitors, in that it owns sources for all its raw materials. In the days of the "old" management, the company suffered much from unfavorable freight rates and discriminations, and made several appeals to the Interstate Commerce Commission with more or, usually, less success. Arrangements undoubtedly will be made eventually to send Colorado steel products by way of the Gould system to San Francisco, and from thence by sea to the Orient, and by the direct railroad route to Galveston, and thence by water to all South American points. With the completion of the Panama Canal this natural advantage will be increased, for then this Colorado steel company will have two tidewater outlets to the Orient—south and west.



LODGE-MUIRHEAD PORTABLE WIRELESS TELEGRAPH PLANT FOR MILITARY USE. THE CURRENT IS GENERATED BY A SMALL CONTINUOUS-CURRENT MOTOR DRIVEN FROM A STATIONARY BICYCLE.

The Department of Anthropology of the University of California has just been enriched by the acquisition of the first skeletons of Pomo Indians possessed by any museum or institution. An expedition sent by the department to Mendocino County, California, has returned with five complete skeletons, several parts of skeletons, many beads and other objects buried with the dead. These will be of great value in determining the qualities and characteristics of the Pomos and their relationships with other tribes of California Indians.

The Pomos practised cremation, which explains the almost complete lack of remains of them. They were of middle height, with round, heavy skulls. Many living Pomos are to be measured and photographed for purposes of comparison with the skeletons, the bones of which are now being measured. When comparisons have been made with the remains of other Indian tribes, the results will be published by the University of California. It is expected that our knowledge of the origin, connections, and wanderings of the Indian tribes will be considerably increased by this determination of their characteristics, and that much information that is not supplied by a study of their language and customs will be obtained.

THE LODGE-MUIRHEAD PORTABLE WIRELESS TELEGRAPH PLANT FOR MILITARY PURPOSES.

An interesting and compact wireless telegraphic plant of the portable type has been constructed by Sir Oliver Lodge and Dr. Alexander Muirhead, the system employed being that evolved jointly by them. The installation, which is self-contained, is especially intended for military operations, and for facilitating transport particularly over difficult country it has been made as compact and light as possible, so that it can be easily stowed away for carriage by mule. It is of sufficient capacity to enable communication to be established over distances up to 50 miles across land, or 150 miles over sea.

The antennæ are carried by bamboo poles, of short, convenient lengths for transport, which poles, when fitted together, form a somewhat cubical structure 40 feet in height. No earth capacity is necessitated and indeed any such connection must be avoided when it is desired to insure the greatest degree of efficiency over long distances.

The transmitting and receiving installations are carried in a small cabinet and occupy the minimum of space. When in use this cabinet is supported upon a folding trestle. The necessary current is generated by means of a small continuous-current dynamo carried in a frame resembling that of a bicycle, the power being supplied by bicycle pedal action, as shown in the accompanying illustration, with the electric valve system devised by Sir Oliver Lodge to accumulate the impulses. For receiving messages the Lodge vibrating needlepoint-oil-mercury coherer with telephone receiver is fitted.

Decrease in Use of Lightning Conductors.

It seems probable that there has been a decided falling off in the use of lightning conductors within the last thirty years. According to the United States census statistics, there were, in 1860, twenty establishments manufacturing lightning rods, which turned out a product valued at $182,750. In 1870 the number of establishments had risen to twenty-five and the value of the products to $1,374,631. In the next decade the number of establishments fell to twenty and the value of the product to $801,192, and finally in 1890 the number of establishments rose to twenty-two, but the value of the product diminished to $483,296. At the census of 1900 the classification in vogue from 1860 to 1890 was abandoned and lightning rods were tabulated in the general classification "Foundry and Machine Shop Products." There are no means of determining absolutely whether the large decrease in the value of the manufactured product from 1870 to 1890 marks a decline in the use of lightning conductors; certain it is, however, that the "lightning rod man" is not so much in evidence as he was in the early seventies.

In large cities the use of lightning rods is not imperative owing to the prevalence of modern steel structures and in general buildings with metal roofs. For buildings that stand isolated in the open country the prudent course would be to install thereon a system of protection from lightning. The extent to which the building should be protected and naturally the expense of installation should bear some definite relation to the value of the building. If the building is insured against loss by fire or lightning, it would not seem advisable to go to the additional expense of erecting lightning rods. In any event the final decision must be reached by the owner of the building. In arriving at his decision he should be guided by the fact that, while absolute security from damage by lightning is attainable only with great difficulty and considerable expense, a reasonable degree of protection can be secured by very simple means, provided the system of protection be devised and erected by a thoroughly competent person.—From a bulletin issued by the U. S. Weather Bureau.

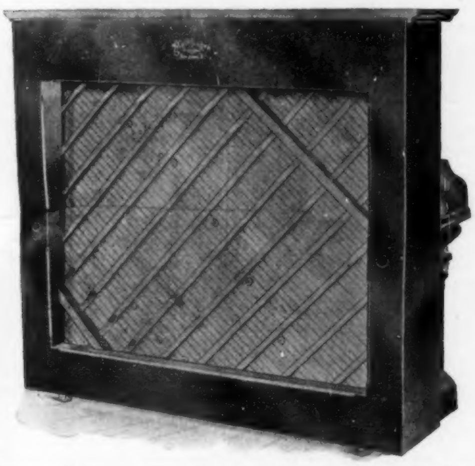
Santos-Dumont's Flight.

Santos-Dumont recently succeeded in driving the "Bird of Prey" many yards into the air, and eleven yards through it. He then came to earth, smashing his propeller wheels and frame. There seems to be no doubt that he actually flew. Fortunately, M. Santos-Dumont was unhurt.

Although the Hall American patent for the manufacture of aluminium has expired, the Bradley patent is still in force, and will not expire until 1909. The Bradley patent is of fundamental importance for the manufacture of aluminium, covering, as it does, the use of the current, as well for the purpose of keeping the electrolytic bath in a molten condition as for effecting its decomposition and setting the aluminium free at the cathode.

THE MATHUSHEK PIANO.

The remarkable resonant quality, the easy and responsive action, and the ability to remain at pitch for an unusual period of time without retuning, which are distinguishing characteristics of the Mathushek piano, have been obtained partly as the result of forty years of scientific design and careful workmanship, and partly because every part of the piano is made at the factory of the company. The building of a first-class piano that will remain first-class for decade after decade of use is by no means a simple proposition,



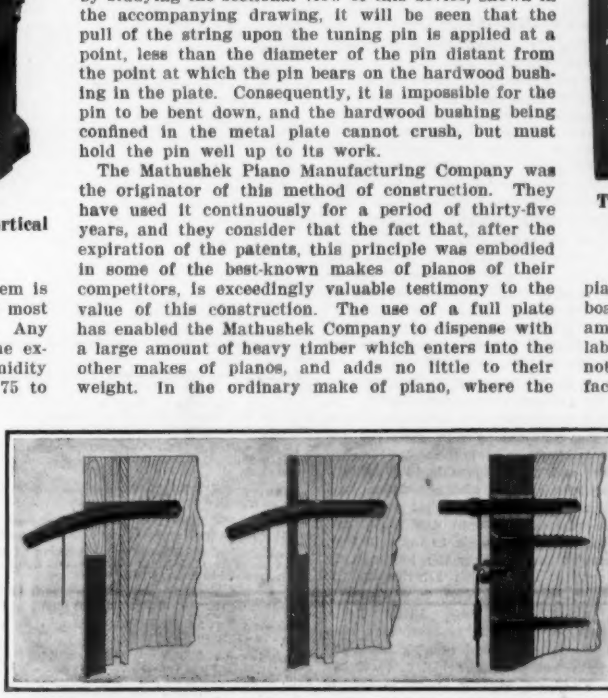
Back of Piano, Showing Absence of Heavy Vertical Posts.

and one of the facts which complicate the problem is that a piano must be prepared to withstand the most severe and widely-diverse climatic conditions. Any given piano is liable to be shipped either to the extremely humid climate of Cuba, where the humidity may range for weeks together anywhere from 75 to 100 per cent; or to the elevated plateaus of western America, where the atmosphere is extraordinarily dry. Seeing that the piano is made up so largely of wood, and that wood, like all fibrous materials, will expand and contract according to the degree of saturation of the atmosphere, the piano manufacturer is confronted, at the very outset, with an exceedingly difficult problem; for unless the frame of the piano, the delicate sounding board, and the many fragile parts of the action are so constructed that they will remain absolutely true to their original lengths, surfaces, and clearances, there will be endless trouble. Under the combined tension or pull of the strings, which may aggregate in the total from 25 to 35 tons, the frame may give ever so little, or the tuning pins may begin to tear through the pinblocks, allowing the strings to slacken and lose their proper pitch. Moreover, the sounding board, which is the very life of the piano, if it be not properly designed, and its materials carefully selected, is liable to lose its proper contour, flattening out and permitting the piano to become "tinny" in tone. Now, the Mathushek Piano Company, during the forty years of their operations, have been giving particular attention to these points, with the result that they have produced an instrument which they claim will keep its tone and pitch longer than any other.

The elements of the Mathushek piano which are distinctive of the instrument, and to which it owes its fine quality of tone and durability, are the special construction of the frame; the use of a full-length, extra heavy iron plate, in combination with a special tuning-pin bushing, and a special design of sounding board whose materials are selected and assembled with a view to securing fine singing quality and permanence of form in the sounding board.

Of the features mentioned above the most important is the full iron plate in combination with the tuning pin bushing, as shown in one of the accompanying illustrations. In the earlier pianos, and in many of the cheaper pianos of the day, the metal plate extended only to the under side of the pinblock. The pins were driven directly into the block, and under the pull of the wires there was a tendency for the pinblock to crush down through the fibers of the wood, enlarging its hole and failing to keep the strings up to pitch. Another method is to carry the plate at a reduced thickness over the face of the tuning block, so as to allow the outermost bearing point of the pin on the wood to be brought a little closer to the point of attachment of the strings. In this case also there is a tendency for the tuning pin to sag until it bears upon the lower edge of the thin iron plate covering. The first scientific attempt to investigate the pinblock problem and provide a thoroughly mechanical means for holding the tuning pins up to their work was made about a third of a century ago, when the Mathushek Company adopted the excellent construction shown in the third of our figures. They realized that the only satisfactory way to take the combined pull of all the strings was to transmit it as quickly as possible to a metal frame or plate of specially stiff construction. Accordingly they designed the plate shown in the accompanying illustration, which is not only of extra thickness throughout, but is stiffened by deep ribs, so disposed as best to meet the heavy strains imposed. The plate was carried clear over the face of the block, and its thickness at the face increased to about 1 inch. The holes are drilled directly through the plate and they are made sufficiently larger than the pin to allow of the insertion of a bushing of hard maple. This bushing is driven into the hole in the plate with its grain transverse to the axis of the hole. When the holes are bored, they are made slightly smaller than the pins, which are driven in to an exceedingly tight fit. Now, by studying the sectional view of this device, shown in the accompanying drawing, it will be seen that the pull of the string upon the tuning pin is applied at a point, less than the diameter of the pin distant from the point at which the pin bears on the hardwood bushing in the plate. Consequently, it is impossible for the pin to be bent down, and the hardwood bushing being confined in the metal plate cannot crush, but must hold the pin well up to its work.

The Mathushek Piano Manufacturing Company was the originator of this method of construction. They have used it continuously for a period of thirty-five years, and they consider that the fact that, after the expiration of the patents, this principle was embodied in some of the best-known makes of pianos of their competitors, is exceedingly valuable testimony to the value of this construction. The use of a full plate has enabled the Mathushek Company to dispense with a large amount of heavy timber which enters into the other makes of pianos, and adds no little to their weight. In the ordinary make of piano, where the



Showing Faulty Method of Adjusting Tuning Pins and the Improved Method Used in the Mathushek Piano, with Full Metal Plate and Hardwood Bushing.

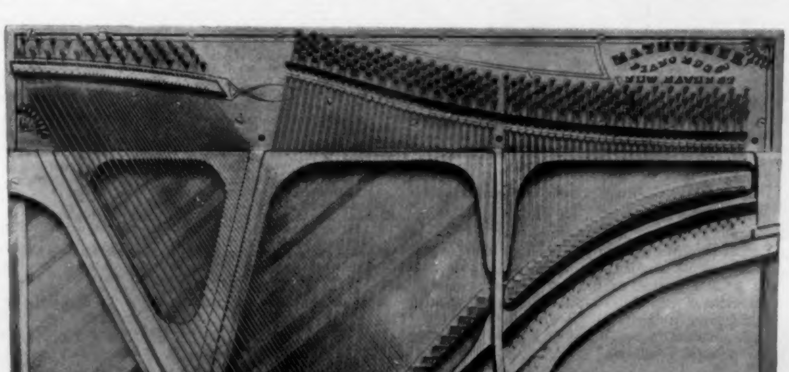
full plate and the tuning pin bushing are not used, the "pinblock" has to be mounted upon a series of heavy vertical wooden posts, which serve to keep the block in position when the strings are being tightened under the process of tuning. In the Mathushek piano, however, there is no such thing as a pinblock, its place being taken by the metal plate and the tuning pin bushing. Consequently, the back of a Mathushek piano shows simply a rectangular frame of moderate thickness and weight, whose function it is to serve as a backing upon which to assemble the main parts of the

The Frame of a Mathushek Grand Piano, Showing Method of Bracing to Keep the Frame to Its Proper Curve.

piano. In the construction of the Mathushek sounding board the company justly claim that they expend an amount of care in the selection of the wood and of labor in building it into the finished board which is not equaled by any other concern. They point to the fact that the board is built up of selected pieces of spruce, none of which is more than one inch in width, as compared with widths of from 4 to 6 inches which obtain in other sounding boards. It is absolutely essential that the sounding board should be at once highly elastic or resilient, and at the same time be free from any tendency to warp and lose its proper curve. These qualities are obtained by assembling the strips with the grain running perpendicularly to the face of the board. Where there is any dip or inclination of the grain from the vertical, the adjoining pieces are assembled so that their grain diverges in opposite directions. The result is that the tendency to warp out of shape is entirely neutralized. The arrangement of the strips is shown clearly in the accompanying photographs.

Almost all piano manufacturers have trouble, during the winter season, from the cracking of the varnish, a defect which is chiefly due to the several coats of varnish not being thoroughly dry. The upper surface of each coat crusts over, but it does not dry entirely through, and it requires but a slight expansion or contraction to break these thin coats, with the result that the upper surface frequently shows innumerable hairlines and even distinct cracks. The company has recently put in an extensive plant which is designed to dry each coat of varnish thoroughly by circulating continuous currents of warm air through the room in which the varnished material has been placed and by exhausting the fumes of the turpentine that evaporate from the varnish in the process of drying. The atmosphere of the room is kept absolutely dry and in continual circulation. The advantage of this system is that the varnishing can be done during the moist atmosphere of the summer (the period in which pianos that are sold chiefly in the fall and winter months are made) with the same certainty of securing a durable surface as in the drier months of the year.

The plant of the Mathushek Piano Manufacturing Company is located in West Haven, a suburb of New Haven, where it has had its home for thirty years past. The buildings are all of brick and are uniformly one story in height. The main building is 416 feet long by 120 feet wide, with a wing 380 feet by 50 feet adjoining. Particularly fine is the new dry house for the drying of the lumber, which has a capacity of 220,000 feet of lumber. It is heated by a large steam fan and much of the excellent quality of the woodwork is due to this feature of the establishment. The buildings are so arranged that the handling of the material during construction is reduced to a minimum.



Front View, Showing the Special Design of Full Plate, the Method of Stringing, and the Sounding Board Made up of Carefully-selected One-Inch Strips.

THE MATHUSHEK PIANO.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

TROUSERS PRESSER AND CREASER.—R. M. Tate, Somerset, Ky. By means of a curved board and a flexible apron the inventor secures uniform pressure on the trousers, and this pressure may be assisted in forming the crease by pressing with the hand or some other substance, an iron, if necessary, upon the apron. When the lever is drawn to strain the apron over the bed, it will be stopped by engagement with the folding leg. The apron is made so as to conform to all inequalities of garment thickness, thus giving pressure in every portion.

EAR-GUARD.—L. D. James, Roselle, N. J. The guard has means for retaining itself in the desired angular relation to the side of the face. The device is so constructed that while thoroughly protecting the ear of the wearer from the wind and rain and preventing entrance of dust or dirt it also serves to convey ordinary or nearby sounds to the auditory canal so that there is no difficulty in carrying on conversation with occupants of automobiles or other vehicles.

Electrical Devices.

ELECTRIC MOTOR.—D. Mendelson, New York, N. Y. The inventor utilizes the attraction value of the remote ends of both electromagnets as well as their proximate ends—that is, in addition to the attraction value between the adjacent ends of the movable magnet and the stationary electromagnet he utilizes also the attraction value of the two ends of these magnets which are remote from their adjacent poles. The next feature consists in means for reversing the current through the movable and the stationary electromagnet at short intervals to clear out or prevent accumulation of residual magnetism.

Of Interest to Farmers.

COTTON PICKING AND HARVESTING MACHINE.—W. H. Le Vin, New Orleans, La. The invention relates to the class of pickers and harvesters in which pneumatic force and suction-hose are used. The objects are to provide a means for the easy application of suction-hose to the ripe cotton-boll at all stages of development of the maturing plants and by means of an automatic picker detach the matured cotton.

INCUBATOR.—G. H. Lee, Omaha, Neb. This improvement pertains to incubators and the object of the inventor is to improve the circulation of the warm air and ventilation of the eggs during incubation. Further objects of the invention are to render the heating of the eggs more uniform and to provide improved means for supporting the eggs in the egg-tray.

CHURN.—G. Lake, Memphis, Tenn. Mr. Lake's invention is an improvement in churns which are provided with vertical rotary dashers that are operated by a horizontal shaft arranged above the churn body and suitably geared with the dasher. It is also applicable for mixing various materials, such as paint, cream, paste, powders, and drugs.

GATE.—O. E. Conat, North Yakima, Wash. One purpose of this invention is to provide a lever-operated gate or a farm-gate that will be perfectly safe, not liable to stop on a dead-center and return to a shut position while a person or vehicle is in transit through the gate, and also to so construct the gate that it will be light, simple, strong, and economic and so evenly balanced that it can be operated with ease by a child.

COMBINED COOP AND BROODER FOR YOUNG CHICKENS.—J. A. Clark, Bolckow, Mo. A combined coop and brooder is employed, embodying special means for preventing overcrowding of the young chicks in the compartment in the structure, due to which hitherto poultrymen or culturists have incurred considerable losses by smothering of chicks in large numbers, it being their peculiarity to crowd together in small space in the coop or brooder however ample the housing provisions. Special means are provided for airing, fumigating, and ventilating.

Of General Interest.

LEAF-TURNER.—K. H. Dillon, Philadelphia, Pa. The apparatus of this inventor is primarily intended for turning sheet music. The individual arms provided for each sheet are operated in succession by means of a treadle, the arms being mounted in connection with a rock-shaft which connects with the treadle by a cord. A torsion spring is provided for returning the shaft after each movement of the treadle. The mechanisms include means for readily permitting the assemblage and rearrangement of the turning arms as desired.

HOIST.—S. T. Wallace, Los Angeles, Cal. The object is to primarily adapt the invention to handling mortar, lime, cement, brick, and other material required to be carried in a hopper or bucket. A carriage is provided adapted to move along a vertical track and mount pivotally a bucket. Coacting with the bucket is a peculiar latch and trip, by means of which the bucket is held during the ascent and automatically released when the top of the track is reached, the bucket being pivoted off center, so that as the bucket is released it automatically tips and dumps its load.

SOAP.—L. H. Reuter, New York, N. Y. This liquid soap or soap solution is for toilet and medicinal purposes and for use in the arts. The method of making soap consists in saponifying oils or fats with an alkali, dissolving the alkaline soap in water and alcohol, allowing the liquid to settle, filtering, adding gradually a predetermined quantity of a salt of perboric acid, stirring the liquid during process of dissolution, keeping temperature low, and adding finely powdered boric acid in small portions.

Hardware.

WRENCH.—J. Christian, Hydraulic, and C. E. Wetzel, Naturita, Col. This implement may be readily adjusted and securely locked in position. The side of a recess remote from the pivot engages a projection upon the wedge when the handle is swung outwardly and tends to move the wedge slightly downward upon the bar, whereby to loosen the wedge from between the frame and the bar. In this construction the long arm of the handle is provided with means for tightening the wedge, while the short arm is provided with means for loosening the wedge.

Machines and Mechanical Devices.

REDUCING AND SEPARATING SYSTEM.—M. S. Weber, Ephrata, Pa. A coffee-berry has, between and within its sections, an integument, which is a continuation of a hull and which is not removed in preparing coffee for the market. This contains tannic acid, which impairs the flavor and renders it unhealthful. To remove this substance and to furnish means for reducing or grinding the berry for use are the objects of the invention.

PULP OR PAPER STOCK SCREEN.—W. W. Wells, Sandy Hill, N. Y. The object of the present invention is to provide a new and improved screen arranged to permit of screening an exceedingly large amount of pulp or paper stock in a short time. It relates to pulp or paper stock screens such as shown and described in Letters Patent formerly granted to O. H. Moore, in 1902 and 1903.

DEVICE FOR MAKING AND FINISHING BOTTLE-NECKS.—W. S. Breeden and H. H. Breeden, Bradford, Pa. The invention relates to a machine for making and finishing the necks of glass-blown jars, bottles, and homeopathic vials; and the purpose is to provide a machine in which a revoluble shaping and polishing tube is employed for that portion of the tube to be formed into the neck, and means for adjusting the bottle to the said tool, and also means for bringing the tool quickly into and out of action with relation to the neck.

TOOTH-BAR.—T. O. Berg, Little Falls, Minn. The improvement is in tooth-bars used in sawmills for shifting and turning logs, one of the objects being to provide a tooth-bar formed in a single casting, thus giving it greater strength and rigidity than is found in bars made in several pieces riveted together, as such a bar is weakened on account of the great number of rivet holes.

Prime Movers and Their Accessories.

ROTARY MOTOR.—A. Primat, 103 Rue Lafayette, Paris, France. Four rigidly-connected pistons rock around a central point, moving in cylinders arranged circularly in the casing of the motor, cast in a single piece, this rocking movement being converted into continuous circular movement by means of a connecting-rod and crank, while the explosive mixture is conducted alternately into each of the four cylinders so that an explosion takes place for each reciprocatory movement, while the suction, compression, and the exhaust of the burnt gases take place alternately in each of the other cylinders, owing to the provision of a set of valves.

Railways and Their Accessories.

SWITCH-TONGUE GUARD.—M. Malia, Scranton, Pa. The invention refers to improvements in guards for the free ends of railway-switch tongues, the object being to provide a simple device to prevent chains, couplings, stretchers, or other devices that might be dragging from a car from catching over the end of an open switch-tongue, thus preventing damage or possible accidents.

Pertaining to Recreation.

MARINE ILLUSION APPARATUS.—F. M. White, Fort Worth, Texas. Two boats are apparently floating in a waterway, and a fixed structure spans the latter intermediate the boats. The first boat is tied to a dock by which passengers are transported along the waterway until the fixed structure is met, and through this they pass onto the second, which is stationary, but capable of being rocked to simulate motion of a boat and also provided with paddle-wheels revolved to produce further illusion of propulsion. Passengers suppose that they pass through the bow to stern of boat instead of making the transfer, as stated. The second boat is moored within a building ornamented with marine views and moving pictures are thrown on a screen, giving a steamboat tour with realistic effect.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Inquiry No. 8350.—Wanted, the name and address of the manufacturer of the Imperial Smoothing Iron, which is heated by gasoline or oil.

Inquiry No. 8351.—Wanted, the name and address of the patentee and present manufacturer of the toy top called the New 20th Century Gyroscope.

Inquiry No. 8352.—Wanted, manufacturers of decorated glass, such as used in clock doors and quaint dials.

Inquiry No. 8353.—Wanted, manufacturers of bricks made of sawdust compressed with coal oil.

Inquiry No. 8354.—Wanted, the name and address of the manufacturer of the Mars Gas Engine Lubricator.

Inquiry No. 8355.—Wanted, the name and address of the manufacturers of the following: Alarm watch, automatic time stamps and registers, and Baldwin's calculating machine.

Inquiry No. 8356.—For manufacturers of adding and listing machines.

Inquiry No. 8357.—For manufacturers of large magnets.

Inquiry No. 8358.—Wanted, makers of models, in the steam line, or just boilers and engines.

Inquiry No. 8359.—Wanted, machinery for the manufacture of alcohol from apples, molasses and sugar.

Inquiry No. 8360.—Wanted, machines for grinding the straw of alfalfa into meal.

Inquiry No. 8361.—Wanted, plans and specifications for a one-story, frame Knoch Doun building, size and appearance suitable for a small machine shop.

Inquiry No. 8362.—For parties engaged in making small buildings, Knoch Doun, suitable for small machine shop.

Inquiry No. 8363.—Wanted, machinery to make wooden bungs, stoppels, etc.

Inquiry No. 8364.—Wanted, a machine for extracting fibers from plants.

Inquiry No. 8365.—Wanted, makers of buckram for carriage work, also manufacturers of malleable corner irons used in buggy work.

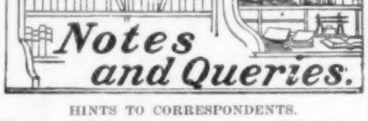
Inquiry No. 8366.—Wanted, makers of reliable melodeon cloth, and a general line of buggy oil cloth.

Inquiry No. 8367.—Wanted, a mill for grinding lumps in cup grease.

Inquiry No. 8368.—Wanted, apparatus for the distillation of wood for charcoal, wood spirit and acetic acid.

Inquiry No. 8369.—Wanted, manufacturers of pulley rims, for motor cycle outfits.

Inquiry No. 8370.—Wanted, makers of glasses with miniature pictures, such as are in knife handles, etc.



HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(10158) E. B. asks: 1. I want to magnetize an ordinary twist drill, making a magnet of it. Will I have to draw the temper of the drill first, or can I make a magnet of it as it is? A. The cutting end is already hard enough for your purpose. Heat the other end to redness and plunge into water, then magnetize. 2. How many amperes of current will it take to magnetize it by means of a coil of 6 or 8 layers of No. 18 silk-covered wire, the current being 110 volts? A. You must be governed by the heating of your coil. Use only so much current as will not heat the coil so that the insulation burns. That would destroy the coil. 3. In making a permanent magnet of tool steel, shall I first soften the steel before magnetizing it, or should it be hardened at the ends? A. Harden the bar at the ends glass hard.

(10159) E. S. D., Jr., writes: 1. I would like to know if you could give me the formula for a solution for bichromate cells, with a good ampere output, in the right proportions, and how to mix it, etc? A. A good solution may be made after the method described in Supplement No. 792, price ten cents. 2. Which is the best form of bichromate to use for making electropolon fluid—the sodium or the potassium? A. The sodium salt is easier of use. 3. What is the best way of amalgamating a zinc? A. The usual method is to clean the plate with dilute sulphuric acid, and then rub mercury over the plate, dipping it into the dilute acid if necessary to make the mercury take to the surface. 4. I would like to know if I could have a battery rheostat made for these batteries, steady current, etc.? A. Yes; though there is little need of one. The amount of current can be regulated by immersing the zincs to a greater or less depth in the liquid.

(10160) W. G. S. asks: 1. What is the output in amperes of the common telephone battery called sal-ammoniac battery? A. The Leclanche cell gives probably 3 amperes as a maximum discharge rate. 2. Also of the dry battery called the 1900, and does the size of the battery govern the number of amperes? A. A dry battery has a small discharge rate. The amperes of discharge of any cell are greater with a large than with a small plate. 3. Also give output in amperes of the common Crowfoot gravity battery, 6 x 8 size. A. You will not be far wrong to take the discharge of the gravity cell at two amperes. 4. Where can I get a table giving the above information? A. Most cells are rated in Carhart's "Primary Batteries," price $1.50 by mail.

(10161) D. C. E. asks: 1. Which is the correct way to place a fuse block—outside or inside the cut-out switch? I have seen fuse blocks put outside the switch, but doubt its being right. A. Switches are placed so that the handles turn down when opened. They cannot then drop by gravity and close themselves. This is much more important than the position of the fuse. 2. Tell me the best oil to use on commutators. A. Use some one of the commutator compounds prepared for this especial purpose.

(10162) H. B. asks: What in your opinion is the best material or substance to cut off or take away the power of the magnet? For instance, a magnet will draw steel toward itself; what can be placed between the piece of steel and the magnet to take away the power of the magnet to draw the steel? A. Iron of considerable thickness is the only screen against the lines of magnetic force.

(10163) P. S. S. asks: What solution is used in plating, for instance silver, or nickel, when batteries are used for circuit? A. For nickel the double sulphate of nickel and ammonium is commonly employed, and for silver the cyanide of silver is almost universally used. Full instructions are to be found in Langbein's "Electro-Deposition of Metals," price $4 by mail.

(10164) A. B. McK. asks: Will you kindly give me what information you can on the following subject? Take a piece of steel and cut in two pieces. Make one as soft as possible and the other as hard as possible; now, what will be the difference in resistance in ohms, if any? A. Barus and Strouhal give the specific resistance of glass-hard steel as 45.7 and of soft steel at the same temperature as 15.9. This is the resistance in thousandths ohms of a bar one square centimeter in cross section.

(10165) M. and S. J. write: If iron or steel is properly cleaned before plating with nickel, it can be burnished like silver without peeling or stripping, therefore, the burnish is a good test for poorly nickeled goods, as the loose nickel will come off.

(10166) C. W. asks: Please inform me as to the difference between an aneroid and a holosteric barometer. A. The word *aneroid* is from two Greek words meaning without liquid, and the word *holosteric* is from two Greek words meaning wholly solid. They are two names for the same thing. There is no difference between them.

(10167) G. M. D. asks: What should be the dimensions, size and amount of wire for a 12-inch coil, 15-inch coil and 18-inch coil? Is there any definite relation existing whereby the above information may be determined from a known coil? A. The dimensions of induction coils are the result of experience rather than of calculation. The properties of the magnetic circuit and the effects of induction are well known, and can be applied to an induction for giving sparks; but almost every builder works from designs which have been wrought out by experiment and are known to give good results. The sizes and windings of certain large coils are given in Hare's "Large Induction Coils," price $2.50 by mail.

(10168) H. O. writes: Can you give us a formula for a preparation for the tempering of mill picks? A. The treatment of mill picks before hardening is of far greater importance than any hardening preparation other than salt water, which is the only menstruum that we can recommend. No hardening solution can recover the lost properties of steel that has been overheated, burnt corners of mill picks, or hammering at above or below a full red heat. Cyanide of potassium dissolved in the hardening water or powdered and sprinkled on the red-hot point before dipping, or even common soap rubbed on the pick before heating, are used by experienced men in the business.

(10169) F. H. P. asks: Is it possible to wind a spark coil of the simple pattern and

make a jump spark coil of it? If so, kindly give directions and state the way it should be coupled up. A. A simple spark coil may be made with a core of iron wire (No. 16) 10 inches long and one inch in diameter. Fasten heads for the spool on this, and cover the core with a few turns of brown paper. Wind No. 14 single cotton-covered magnet wire on this to a depth of about ⅝ inch, insulating each layer from the next by a layer of paper. It is better to give each layer a coat of shellac also. The coil is used in series with a battery, and the spark is obtained when the circuit is broken. With six or eight strong cells a thick spark will be given.

(10170) F. H. R. writes: I have a stereopticon lantern, and have been experimenting some with it. For a screen I have a blank wall tinted an orange red. Can you tell me what colored glass I can use with my lens in order to throw a white light upon the red surface? A. To obtain the best effect you must find a glass of a tint the exact complementary of the color of the wall. This will be a bluish green. Of course much light is lost both by the absorption of the wall and of the glass. We should suppose that very little would be left.

(10171) G. W. H. asks: How can I connect the wires on the carbon element of an open circuit, home-made battery which I have? I use sal ammoniac. They work fine for about two weeks, when I have to renew connections on the carbon. It seems the fluid rises within the carbon and corrodes the wire. Have tried paraffine and also rubber on the outside, but to no avail. The carbons are arc-light pencils, well up out of the fluid. A. Dip the tops of the clean and dry carbons into melted paraffine till they are saturated with the paraffine as far as the surface of the liquid, so that the sal ammoniac cannot climb through the carbon, nor over the outside of it. In sal ammoniac cells usually there is a thick head of composition on the upper end of the carbon.

(10172) A. K. M. asks: 1. Can you let me know the cheapest and most simple way of producing oxygen? A. Oxygen is generated by heating a mixture of manganese dioxide and potassium chlorate in a metal flask. Care is necessary in doing this not to disengage the gas too rapidly and thus produce an explosion of the apparatus. The materials also should be tested in advance to see that they will give up the oxygen quietly and not too rapidly. 2. Can you explain what caused electric sparking at point of connecting 3-inch suction pipe let in from top of tank car containing a mixture of turpentine and naphtha, the discharge pipe from pump leading to large storage tank of several thousand barrels of the same mixture? Also being connected with large storage tanks of gasoline and carbon oil. The suction pipe being of iron, every attempt made to connect would cause heavy sparking, so that the men dared not connect for fear of fire, the temperature being about 15 deg. Fahr., having had cold weather for some time; whereafter the men got a suction pipe of galvanized iron, let it down into the tank car, and in connecting there was no more sparking. A. The charge of electricity was due probably to the very cold air and friction of the pipe and pump. If the liquid was not set on fire by the sparks which passed while the men held the pipe near the tank, it could not have been after they had brought the ends into connection with each other. The danger would then have been over. These oils are not conductors of electricity.

(10173) J. F. C. asks: 1. What advantages has the double pole receiver over the single pole (as they are called) electrically? Why would not one coil, the same resistance of the two, placed on one pole of a permanent horseshoe magnet (traversed by an alternating current) affect the magnet flux as much as the two coils of half the resistance, one placed on each pole? A. A horseshoe magnet is always stronger than a bar magnet of the same number of turns of wire upon its poles, and so a double pole magnet in a telephone will act more powerfully than a single pole of a straight magnet. 2. Is pure soft iron free from resistance to magnetic flux? What is the resistance of the air to magnetic flux as compared to pure Norway iron? A. The number of lines of force which will pass through iron as compared with air under the same degree of magnetization varies with the degree of magnetization. It may be as much as 5,000 times as many, and it may be only a few times as many when saturation is nearly reached. See the table of permeability in electrical works such as Foster's "Pocket Book," price $5 by mail. 3. Which is correct to say, that a magnet attracts a piece of soft iron because it lowers the resistance of the magnetic flux, or that an opposite magnet is induced in its mass by induction? A. When a piece of iron approaches a magnet it both becomes a magnet and furnishes an easier path for the lines of force than the air. 4. Is the *greatest* force of attraction exerted in a magnet in attracting opposite poles of itself? A. We do not know whether a magnet works most in attracting its own poles or not. 5. What electrical disturbance is made by the action of the wind on telephone wires that a receiver takes it up? A. The noise to which you refer in a telephone is produced by vibrations caused by induction of adjacent wires and not by the friction of the wind. The wind produces no electrical disturbances.

NEW BOOKS, ETC.

THE CHEMISTRY OF PAINTS AND PAINT VEHICLES. By Clare H. Hall, B.S. New York: D. Van Nostrand Company, 1906. 12mo.; pp. 134. Price, $2.

In the great mass of analytical chemistry it is often difficult to discover particular methods applying chiefly to any one subject, or, rather, to find those methods concisely collected between the covers of a single volume. The author has attempted to sift out those methods which apply particularly to the analysis of paints, while at the same time dwelling with a certain degree of completeness upon the most important physical characteristics of the raw material; for it will be understood that no chemist can be proficient in the analysis of paints without a thorough knowledge of all the materials with which he comes in contact. Of course, the limits of the book make it impossible to give more than the general facts regarding these raw materials. While the information has been written from the standpoint of the chemist, the author tries to bridge the space between the laboratory and the factory, and to show that the less this space is in evidence, the better will be the resulting product of the manufacturer.

DWARF FRUIT TREES. By F. A. Waugh. New York: Orange Judd Company, 1906. 16mo.; pp. 125. Price, 50 cents.

American agricultural and horticultural conditions are usually on so large and extended a scale, especially in a commercial sense as well as in a physical one, that these subjects have hardly been introduced as avocations and pastimes, and the growing of trees largely for pleasure has been hitherto extremely limited. The author of this book will doubtless succeed in his undertaking of arousing interest in dwarf fruit trees more as a pastime than as a commercial enterprise, though the latter is by no means precluded.

THE AMERICAN STEEL WORKER. By E. R. Markham. New York: The Derry-Collard Company, 1906. 16mo.; pp. 339. Price, $2.50.

Mr. Markham's book, which has reached its second edition, is based on the experience of nearly a quarter of a century in the selection, annealing, working, hardening, and tempering of the various sorts and grades of steel. The new edition contains an interesting section on high-speed steel, which includes the latest information on the subject, thereby bringing the text to a condition of completeness which was lacking in the earlier edition.

JAHRBUCH DER NATURWISSENSCHAFTEN 1905-1906. By Dr. Max Wildermann. Freiburg im Breisgau: Herderfsche Verlagshandlung, 1906. 8vo.; pp. 501. Price, $2.

The interesting volume edited by Dr. Wildermann, with the collaboration of eminent experts, is a comprehensive survey of the advances that have been made in the natural sciences during 1905-6. The latest developments in physics, chemistry, astronomy, mineralogy, zoology, botany, geology, and many other fields of science are discussed, often in detail, and frequently with excellent illustrations. This book will be found valuable for the general reader, who desires to keep in touch with the general advances of our age in science and natural history.

OUTLINES OF THE EVOLUTION OF WEIGHTS AND MEASURES AND THE METRIC SYSTEM. By William Hallock, Ph.D., and Herbert T. Wade. New York: The Macmillan Company, 1906. 8vo.; pp. 304. Price, $2.25.

The authors declare themselves flatly in favor of the metric system, both on the ground of its intrinsic superiority and because of the manifest advantage of having a universal system of weights and measures for all industries throughout the world. A complete and fair history of the metric system is given in the various chapters of the volume, with its logical development and chief characteristics. An account is given of the experience of the European nations which have tried and adopted the system. The citation of the authorities is voluminous, and the references to the bibliography of the subject are extensive. The tables of equivalents have been carefully worked out, and are put in very convenient form, and therefore as a work of reference on the subject the book will doubtless be found scholarly and useful.

ITALIAN VARNISHES. By George Fry, F.L.S., F.C.S. London: Stevens & Sons, Ltd., 1904. 16mo.; pp. 170.

Little attention has apparently been given to the subject of the varnishes used on the old Italian musical instruments, and the theory has been accepted that these are oil varnishes, or rather an oil varnish colored to suit individual tastes. The author gives an account of the interesting research which forms the subject of the treatise, and he shows, to his own satisfaction at any rate, that the old violin makers used as the constituents of their varnishes the natural products of coniferous trees and the flax growing in their immediate vicinity, both abundant and easily procurable, and that therefore the varnish was a simple one composed of resin and turpentine, or both of these with linseed oil. The work is interesting from the standpoint of the chemist as well as from that of the general reader.

FIELD TO DAIRY. By William Shepperson, F.C.S. London: Simpkin, Marshall & Co., Ltd., 1906. 16mo.; pp. 49. Price, 80 cents.

The object in gathering the material in "Field to Dairy" was to give in as concise a form as possible the essential points pertaining to the management of fields and cattle, and the production of milk, cream, butter, cheese, and various by-products in the dairy. The little volume will be found a handy book of reference where time is lacking for the study of a completer history of any particular subject.

FARM SCIENCE. By Joseph E. Wing, P. G. Holden, Waldo F. Brown, Hon. W. M. Hays, Thomas Shaw, Clinton D. Smith, Cyril G. Hopkins, and Fred R. Crane. Chicago: International Harvester Company of America, 1906. 32mo.; pp. 128.

This excellent little book has been compiled by a number of eminent specialists for the particular purpose of assisting American agriculturists in the work of farm management. With this end in view, the highest authorities in their respective fields of research have been called upon to prepare a number of special articles covering the results of extended experiments involving the most important operations on the farm, and the subjects treated deal substantially with every branch and phase of modern agriculture and cover a wide range of thought. It is generally conceded that the astonishing progress made in agriculture in this country is due mainly to the intelligence of the American farmer, notwithstanding that considerable credit must be given our unlimited agricultural resources, and to the material assistance rendered the farmer by the work of inventors who, recognizing the necessity of improved methods, have supplied both machines and implements to lighten or entirely obviate manual labor. A careful perusal of "Farm Science" will undoubtedly suggest methods of improving the quality or yield of the crops, of making the dairy more profitable, and of securing larger results with less labor.

ROPP'S COMMERCIAL CALCULATOR AND SHORT-CUT ARITHMETIC. By C. Ropp. Chicago: C. Ropp & Sons, 1906. 8vo.; pp. 160. Price, $1.

In this convenient volume the author gives a new, complete, and quite comprehensive system of tables intended to save time and labor in the various phases of commercial calculation. The text includes condensed and simplified explanations, rules, and reviews of the essence of arithmetic and mensuration. It is designed for the use of farmers, mechanics, business and professional men, bankers, and storekeepers. The explanations of the principles of arithmetic, mechanics, and mensuration are well prepared, and the book will doubtless make the study and use of figures easy, if not interesting, for the user. Altogether, the work is convenient, practical, and labor-saving, and will be found useful by business men.

SCHOOL TEACHING AND SCHOOL REFORM. By Sir Oliver Lodge. London: Williams & Norgate, 1905. 16mo.; pp. 171. Price, $1.20.

This book by the well-known English educationalist, Sir Oliver Lodge, should be of interest and value to teachers in Great Britain and this country. The text comprises a series of four lectures on curricula and methods, and they were intended for the information of teachers in general, notwithstanding that they were delivered before the secondary teachers and teachers in training at Birmingham.

GAS ENGINES AND LAUNCHES. By F. K. Grain. New York: Forest and Stream Publishing Company, 1905. 16mo.; pp. 123. Price, $1.25.

This little manual is a collection of a series of papers published in Forest and Stream on internal-combustion engines and launches. The subject is placed before the reader in terms which are easily understood even by the inexpert, and technicalities have been avoided wherever possible. The illustrations are clear and sufficient in number advantageously to supplement the text.

PORTLAND CEMENT. By Richard K. Meade, B.S. Easton, Pa.: The Chemical Publishing Company, 1906. 8vo.; pp. 385. Price, $3.50.

One of the latest contributions to the literature of the cement industry is this book, which is really a second and enlarged edition of a small handbook by the same writer published some years ago. Of course, the advance of the industry necessitated the rewriting of large sections of the earlier work, and the addition of much information and data collected since then. The analytical methods given have been found satisfactory in the writer's laboratory. The section on the analyses of cement is exceptionally good.

THE ELECTRICAL NATURE OF MATTER AND RADIOACTIVITY. By Harry C. Jones. New York: D. Van Nostrand Company, 1906. 8vo.; pp. 212. Price, $2.

Prof. Jones's book is a collection of a series of articles which he wrote for the Electrical Review, and the correlation of the subjects under consideration, as well as the general interest of which they are worthy, thereafter led the discussion to be placed in compact form in a single volume. The text has been carefully revised with the assistance of Dr. H. S. Uhler. The object of the lectures was to place as far as possible, in non-mathematical language, the important facts and conclusions in connection with the work on the subject, and this has been done in the interest of those who, while having a really scientific interest in the developments in physics and physical chemistry, nevertheless are ill equipped technically and mathematically to comprehend a purely scientific treatment of the subject. Thus, while the work has been written in a semi-popular style, the subject has doubtless been covered with scientific accuracy.

THE ANALYSIS AND SOFTENING OF BOILER FEED-WATER. By Edmund Wehrenfennig in collaboration with Fritz Wehrenfennig. Translated by D. W. Paterson, M.E. New York: John Wiley & Sons, 1906. 8vo.; pp. 290. Price, $4.

The present form of this book is the result of a number of changes from the original one, in which it appeared as an essay in "Das Organ fuer die Fortschritte des Eisenbahnwesens" of Austria. The translator first performed that part of the work for his own personal information, but it was found to contain so much excellent data of practical value and general interest, that it was decided to place the book before the public. The chemistry of the subject is treated with great care, and includes simple methods of analyzing water intended for boiler feed. These methods are explained in such a manner that they can readily be understood even by the layman. Certain European railroads have been very successful in softening water intended for steam purposes, and the exposition of their methods should be of use and value to American roads introducing or contemplating the utilization of water-softening plants.

NEW EXTENSIVE A B C TABLES FOR AZIMUTH, POSITION LINES, ERROR IN LONGITUDE DUE TO AN ERROR IN LATITUDE, ETC. By S. Mars. Groningen: P. Noordhoff, 1906. 12mo.; pp. 56.

ILLOGICAL GEOLOGY. The Weakest Point in the Evolution Theory. By George McCready Price. Los Angeles: The Modern Heretic Company, 1906. 8vo.; pp. 93. Price, 25 cents.

UNSOLVED PROBLEMS IN METALLURGY. By Robert Abbott Hadfield, M.Inst.,C.E. London: The Institution of Civil Engineers, 1906. 12mo.; pp. 36.

DIE ABHANGIGKEIT DER BRUCHLAST VOM VERBUNDE. By Dr. Ing. Fritz v. Emperger. Berlin: Wilhelm Ernst & Son, 1906. 8vo.; pp. 47.

AUTOMOBILI STRADALI E FERROVIARIE PER TRASPORTI INDUSTRIALI. By Ing. Ugo Baldini. Milan: Ulrico Hoepli, 1906. 8vo.; pp. 351.

OPERE. Vol. II. By Galileo Ferraris. Milan: Ulrico Hoepli, 1903. 8vo.; pp. 473.

THE QUEST OF THE GERM. With Observations Thereanent. By Eugene H. Wood, A.M., M.D. Milwaukee: Published by the Author, 1906. 12mo.; pp. 229. Price, 75 cents and $1.50.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending September 11, 1906.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Account register, Staples & Potter........ 830,936
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Air and other gases, apparatus for liquefying, R. P. Pictet 830,613
Air compressor, compound, E. Hill 830,503
Air or oxygen, apparatus for producing highly ozonized, A. Dechaux 830,975
Amalgam carrier and plugger, H. W. Arthur 830,872
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Boat, sailing, T. Jensen 830,720
Boiler. See Steam boiler.
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Boiler trap, C. Dennis 830,649
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Boot and shoe ware and other goods, appliance for inserting beading in, E. Townsend 830,255
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Bore holes, means for surveying, H. F. Marriott 830,730
Bottle and stopper, milk, C. M. Conley.... 830,886
Bottle closure, H. A. Olsson 830,735

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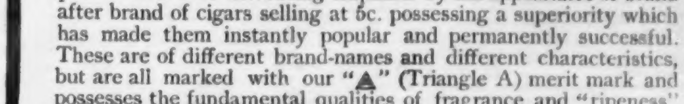

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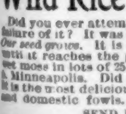
Pianos or musical instruments, pedal board and pedal for self-playing, W. F. Cooper	830,823
Pie guard, pastry, B. L. Cole	830,492
Pillow, cool, C. B. Hurst	830,837
Pillow, sham, B. F. Cary	830,970
Pin attachment, G. W. Fletcher	830,777
Pipe reamer, C. P. Arnold	830,760
Pitching machine, Kieffer & Rebsamen	831,006
Plane, bench, J. A. Traut	830,541
Planter, corn, L. H. McCormac	830,517
Planter marker, corn, O. B. James	830,505
Plasterer's float, O. M. Spangler	830,683
Plow, P. F. Freeman	830,657
Plow rudder, C. W. Bixby	830,637
Pointer, T. H. Costello	830,495
Potato digger, O. Knoerzer	831,008
Potential indicator, J. B. Taylor	830,938
Powder container top, F. W. Murray	830,611
Power from car axles, mechanism for transmitting, D. E. Johnson	830,839
Press roll feed attachment, platen, Bruckman & Maiden	830,766
Presswork recorder, Palmer & Winnacott	830,923
Printing apparatus, L. Schlesinger	830,617
Printing, developing, fixing, washing, and drying apparatus, multiple, F. S. R. Prentiss	830,741
Printing machine cylinder, G. F. Read	830,527
Printing press, rotary, F. M. Turck	830,751
Pump, duplex steam, J. Kofoed	830,723
Pump governor, N. G. Copley	830,972
Radiator, hot water, F. H. Wheelock	830,946
Rail, Taylor & Voynow	830,623
Rail joint, N. P. Walters	830,754
Rail joint, A. L. Plimpton	830,847
Rail tie and fastening, N. P. Walters	830,755
Railway crossing gate, automatic, C. Hocker	830,788
Railway crossover, G. A. Ransom	830,927
Railway motors and means for mounting the same, gear case for, A. Grammont	830,830
Railway, multiple speed, L. McHarg	830,733
Railway switches and signals, apparatus for moving, F. P. J. Patenall	830,522
Railways, etc., means for anchoring and securing flat bottomed rails in the permanent ways of, A. MacLeod-Carey	830,607
Rake, C. F. Faes	830,580
Razor, safety, L. T. Snow	830,746
Refrigerator, window, C. Spadavecchia	830,861
Resetting switch, automatic, S. H. Couch	830,770
Rifle construction, C. Hamilton	830,587
Rifle front sight, T. A. Watson	830,868
Rifles, telescope mount for, F. W. Mann	830,729
Rock drill, C. H. Shaw	830,744
Roller feed table, J. W. Gocher	830,990
Rotary engine, J. W. Stodders	830,621
Rotary engine, J. Rodberg	830,673
Roundabout, H. G. Traver	830,688
Ruffler, A. G. Lamb	830,508
Sanding device, E. V. Planta	830,525
Sash controlling mechanism, J. C. Lodor	830,604
Saw, endless chain, J. Smith	830,860
Saw, metal, H. R. Geer	830,779
Saw, metal cutting, H. R. Geer	830,778
Scale, computing, A. De Vilbiss, Jr.	830,976
Scale, suspension bearing, W. H. Sargent	830,856
Scale, weighing, W. H. Sargent	820,930
Seal, L. A. Brown	830,565
Sealing machine, bottle, A. A. Wood	830,551
Semaphore, J. F. Webb, Jr.	830,629
Sewing machine, Bolton & Weiss	830,562
Sewing machine, W. Arbetter	830,690
Sewing machine sewing receptacle, folding, E. E. Boller	830,638
Shaft support, S. W. Lanham	830,793
Sheet metal bending machine, M. D. Sadtler	830,929
Shoe, M. V. B. Evesson	830,655
Shoe, L. H. Voss	830,753
Shoe beading machine, W. B. Keighley	830,901
Shoe holder, A. R. Anderson	830,632
Shoes, box for toes of, J. N. Moulton	830,911
Shovel tooth, steam, W. H. Bates	830,960
Shutter fastener, P. P. Orum	830,672
Shuttle, self threading, J. B. Daudelin, reissue	12,531
Silicon, melting and casting, H. N. Potter	830,738
Sketch board, E. F. Chandler	830,769
Slicing machine, E. F. Smith	830,935
Smoke consumer, C. R. Blankenbiller	830,560
Smoke consumer, R. Brien	830,765
Snow plow, B. Wilken	830,871
Snow plow, P. Hannagan	830,993
Sole pattern and sole rounding machine, J. J. Gillispie	830,584
Spark arrester, A. N. & A. M. Holdaway	830,592
Speed indicators, circuit closing device for, H. Dahl	830,497
Spindle, H. C. Smith	830,806
Sprinkler, Bryan & Jones	830,963
Square, bevel, and protractor, combined, E. H. Long	830,727
Stackers, fan for pneumatic, J. K. Sharpe, Jr.	830,618
Stall, C. A. Makowski	830,842
Stand. See Umbrella stand.	
Stand, H. Wessels	830,943
Steam boiler, oil burning, Heintzelman & Camp	830,833
Steering mechanism for self-propelling machines, G. W. King, et al	830,721
Stone, artificial, F. Kellen	830,597
Stone blocks, machine for making artificial, Kynett & Toops	830,726
Stovepipe joint, C. C. P. Lund	830,907
Stoves, dustless ash sifter and draft regulator for, P. Hannan	830,895
Strap handle, double, J. C. McClure	830,732
Straw carrier attachment, H. S. Hanson	830,588
Street cleaning machine, H. Borden	830,490
Superheater, Cole & Mellin	830,822
Swing, circle, H. G. Traver	830,687
Talking machines, safety device for sound boxes for, L. P. Valiquet	830,689
Teaching the playing of stringed instruments, device for, J. W. Myers	830,915
Telemeter, coincidence, A. Konig	830,668
Telephone pay station device and system, A. H. Dyson	830,653
Telephone receiver hook, D. Howard	831,001
Telephone switch hook, J. A. Wotton	830,696
Telephone system, W. W. Dean	830,575
Telephone system, A. H. Dyson	830,951
Telephone test set attachment, G. L. Rosenberger	830,675
Telephone transmitter and receiver, combination, C. C. Gilchrest	830,983
Telephony, A. H. Dyson	830,654
Theatrical machinery or apparatus, Garnier & Grobon	830,988
Threading die, W. B. Pearson	830,736
Threading machines, cut-off thread gathering attachment for, B. Zach	830,814
Time element device, J. G. Statter	830,537
Tire for vehicle wheels, cushion, L. H. Barry	830,873
Tire, wheel, N. Beckwith	830,488
Tobacco pipe, L. Swenson	830,864
Toothpicks, mechanism for cutting wooden, J. M. Rounds	830,852
Torpedo applier, railway, P. F. Sullivan	830,622
Toy, C. Ewing	830,774
Toy, W. D. Groesbeck	830,783
Trace connection, J. T. Bressler	830,877
Trace fastener, J. F. Harris	830,712
Track gage, level, and alining apparatus, combination, E. A. Brown	830,640
Track laying apparatus, portable self, R. O. Rood	830,851
Trap. See Animal trap.	
Treadle, removable machine, S. D. Bacband	830,818
Trolley controlling apparatus, F. E. Case	830,568
Trolley pole controller, J. J. Tartt	830,686
Trousers presser and creaser, H. C. Warfel	830,756
Trousers stretcher and coat hanger, combined, S. B. Bedinger	830,874
Truck, breakdown, F. C. Wheeler	830,945
Truck, engine or tender, T. B. Adams	830,554



E. H. BEACH, Editor

Trucks, combined bunk and chock block for logging, T. G. Haywood	830,786
Tube cleaner, A. H. Swartz	830,808
Tuck marker, A. G. Lamb	830,507, 830,509
Tufting apparatus, H. J. Jacobs	830,504
Turbine buckets, means for attaching, J. G. Callan	830,878
Turbine, elastic fluid, O. Junggren	830,900
Turbine engine, steam, Eberhardt & Weghorst	830,890
Umbrella, C. T. von Wallmenich	830,866
Umbrella stand, T. L. Monaghan	830,843
Urinal, L. H. Pleins	830,846
Vacuum drier, E. Passburg	830,521
Valve, S. A. Plough	831,018
Valve controlling device, gas, I. C. Peterson	830,845
Valve for gas supply pipes, automatic safety, A. W. Jenczewsky	830,719
Valve for steam boilers, blow-off, J. B. Barnes	830,557
Valve, steam actuated, E. E. Thomas	830,811
Vanner, pneumatic, A. H. Stebbins	830,538
Vaporizer, J. E. Van Ness	830,626
Vehicle, motor, E. Chaquette	830,642
Vehicle propelling apparatus, A. Ahlbrecht	830,631
Vehicle running gear, F. L. Binford	830,961
Vehicle spring, C. L. Thomas	830,809, 830,810
Vehicle storm top, W. A. Hunter	830,664
Vending machine, R. Ziebell	830,815
Ventilating device, R. Taylor	830,749
Ventilator grate, S. Petersen	830,926
Vessel, marine, J. W. Martin	830,908
Vise and drill, combined, P. J. Harrah	830,896
Votometer, G. E. Campbell	830,879
Wagon attachment, F. C. G. Zimmermann	830,816
Wagon brake, G. O. Doll	830,650
Wagon brake, J. R. Ezzell	830,656
Wagon, dumping, F. M. Krasmer	830,724
Wagon seat support, adjustable, Keller & Schueler	831,005
Walls, printed frieze for, H. M. Schmitz et al	830,931
Washboilers, device for removing clothes from, O. Carlson	830,880
Washing machine, R. N. Brent	830,876
Watch registering and indicating device, T. H. Watson	830,627
Water purifying apparatus, C. L. Kennicott	830,790
Water softening and clarifying apparatus, A. L. Zeigler	830,552
Weed cutter, J. T. Short	830,805
Weigher and register, automatic, H. B. Ruggles	830,676
Weighing and bagging machine, H. G. Scott	830,932
Weighing mechanism, Soderquist & Fettel	830,682
Welding, machine for electrically, L. S. Rolland	830,674
Well cap, H. A. Gray	830,782
Wheel sand box, L. E. Waterman	830,691
Whiffletree hook, J. G. Myers	830,914
Winding machine, ball, F. J. Faulkner	830,703
Window for banks, automatic, G. K. Russell	830,928
Window ventilator, S. B. Goman	830,829
Wire stretcher, C. A. Miller	830,797
Wire stretcher, S. H. Thompson	830,854
Wire tightener, L. G. Dunn	830,978
Wort, treating and aging, H. E. Deckebach	830,576
Wrench, J. H. Shepherd	830,619
Wrench, J. A. Holton	830,999

DESIGNS.

Brush back, A. E. Hathaway	38,230
Button-hook or similar article, handle of a, A. E. Hathaway	38,229
Finger ring, J. L. Herzog	38,235
Jug or similar article, C. J. Noke	38,234
Mirror back, A. E. Hathaway	38,231
Refrigerator, C. H. Boeck	38,237
Rubber matting, A. J. Whisler	38,238
Sewing rack, W. C. J. Lang	38,236
Soda water tumbler holder, G. C. Lyon	38,233
Spoon, fork, or similar article, handle for a, G. Strohbaker	38,232

TRADE MARKS.

Antiseptic germ, insect, and worm destroyer, National Medical Co.	56,323
Beer and lager beer, Harvard Brewing Co.	56,321
Beverages, certain named, Griggs, Cooper & Co.	56,341
Candies of all kinds, including chocolate candies, J. Govatos	56,319
Canned hominy, Sunlight Hominy Co.	56,340
Chemical compound for certain named purposes, G. W. Royce	56,345
Cigarettes, cigars, smoking and chewing tobacco, Maspero Freres	56,337
Clothing, certain named, Bedell Co.	56,317
Cotton damask, Rosemary Manufacturing Co.	56,328
Cotton piece goods, Kunhardt & Co.	56,322
Cotton piece goods and blankets, Neuss, Hesslein & Co.	56,324, 56,325
Cotton sheetings, H. Norden	56,326
Electrical accumulators, C. Jeantaud	56,303
Electrical apparatus, machines, and supplies, certain named, Simplex Electric Heating Co.	56,315, 56,316
Files and rasps, Arcade File Works	56,301
Gas generators, Acme Gas Co.	56,300
Knives, scissors, and shears, H. Hessenbruch	56,302
Leather polish, Whittemore Brothers & Co.	56,343
Locks, padlocks, and keys, Miller Lock Co.	56,304 to 56,314
Mirror plates, Semon Bache & Co.	56,329
Pens, Perry & Co.	56,338
Powder, tooth, Vail Brothers	56,339
Powders, tooth, Jordan Marsh Co.	56,335
Salve, Hutchins Eczema Salve Co.	56,334
Salve for treatment of boils and carbuncles, Carboil Salve Co.	56,318
Starch, laundry, Griggs, Cooper & Co.	56,320
Syrup, honey, and sorghum, Griggs, Cooper & Co.	56,333
Tobacco, smoking, Axton-Fisher Tobacco Co.	56,332
Tonic beverage, carbonated, A. R. Champney Co.	56,344
Washing compound, Atlantic Manufacturing Co.	56,331
Whisky, C. Kamper's Sons	56,336
Whisky, H. W. Huguley Co.	56,342
Yarn, certain named, Whittier Mills	56,330

LABELS.

"Albany Heel Plates," for heel plates, F. W. Whitcher	13,084
"Buckhead Chloride Lithia Water," for mineral water, T. S. Wheelwright	13,080
"Bugbane," for insecticide, L. Terbune	13,079
"Drain Ice Bag," for ice bags having a drainage, American Rubber Co.	13,078
"Eye-Septic," for eye medicine, T. L. James	13,081
"Grand Dad's Liniment," for liniment, J. N. Phillips	13,082
"Noxall," for flour, Scott County Milling Co.	13,083

PRINTS.

"Antiphlogistine Girl No. 1," for medicine, Denver Chemical Manufacturing Co.	1,780
"Antiphlogistine Girl No. 2," for medicine, Denver Chemical Manufacturing Co.	1,781
"Antiphlogistine Girl No. 3," for medicine, Denver Chemical Manufacturing Co.	1,782
"Antiphlogistine Girl No. 4," for medicine, Denver Chemical Manufacturing Co.	1,783
"French Electro Medicated Crayon," for medicated crayon, H. A. Ward	1,786
"Rex Bitters," for bitters, Rex Bitters Co.	1,784
"Yeast Foam Raises the Dough," for yeast, Northwestern Yeast Co.	1,785

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